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The Empire Cotton Growing Review

Journal of the Empire Cotton Growing Corporation

Vol. VI. 1929

Edited by
J. C. Willis, M.A., Sc.D., F.R.S.

Published by
P. S. King & Son, Ltd., 14, Great Smith St., London, S.W. 1
for the Empire Cotton Growing Corporation

Quarterly: Price 1s.
Annual Subscription, 5s. post free

THE
EMPIRE COTTON GROWING
REVIEW

VOL. VI. JANUARY, 1929. NO. 1

APPLICATIONS OF SCIENCE IN AGRICULTURE

BY

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IT is widely recognized that science finds useful application in agriculture; indeed, the degree of recognition is so great as to be sometimes almost embarrassing. At the present time there is a tendency to look to science as the best, if not the only, means to find a way out of the difficult situation in which agriculturists in all countries find themselves: not uncommonly the man of science is called in—late in the day, perhaps—to retrieve the errors and perchance to share the blame of mistakes by politicians, business men, and so-called practical experts, who have embarked on some enterprise and got themselves into a situation out of which extrication is difficult. All this is a new development: it is in striking contrast to the position of thirty years ago, when the scientific worker in agriculture was at best only tolerated and rarely taken seriously. The British Government would have nothing to do with him; no grants were available—indeed, a distinguished Civil Servant, in response to a request for a research grant, declared that he could not conceive of circumstances in which any Government would be interested in scientific research for agriculture. It is a great change, and it has proceeded rapidly, mostly since the War, though it was not started by the War, but had, in fact, set in before that, and indeed was well on its way in 1914.

The actual progress of events, so far as Great Britain is concerned, is well known. In 1890 the Government of the day, having raised money by taxing whisky, spent it on Technical Education, including Agricultural Education: in consequence Agricultural Colleges and Departments of Universities were started and serious efforts made to educate young people for agricultural life: some bolder spirits even tried to educate farmers. The more progressive of the teachers soon discovered the need for learning something of the subject themselves, and they proceeded to make experiments with the purpose of gaining knowledge. These men prospered as they deserved. Farmers caught the spirit, and experimental farms and plots sprang up all round the countryside. Much information of great value to the grower was obtained, and its value was widely recognized. The Government made a sharp distinction between education and research, however, and while they would make grants for educational purposes, they made none for research. The distinction always puzzled the laymen, and it was abolished in 1909-10, when Mr. Lloyd George secured the Act setting up the Development Fund, out of which increasing amounts have been voted for research each year. So profoundly has research impressed the farmers that when the £1,000,000 was allotted to agriculture in compensation for the repeal of the Corn Production Act, the farmers themselves asked that it should be used for "research and education," because, as the President of the National Farmers' Union truly said, "Without research there can be no agricultural education."

Now this position could not have been reached without very substantial reasons. English farmers are the last people to be dazzled by the glamour of pure scholarship or University prestige: they have no innate veneration for the professor as such. The fact that agricultural science has attained so high a position is substantial proof that it deserved success.

If one looks over the records of agricultural improvement for the past eighty years, it is easy to see why this position has been attained.

The first great triumph of science was in 1840, when fifty years of work by chemists and botanists had revealed the essential facts of plant nutrition, and Liebig, Lawes, and Gilbert put this discovery to practical use by the introduction of artificial fertilizers. The great improvement of crop yield, and, perhaps more important, the increased certainty of yield in bad seasons, dispelled the old fear of catastrophe and famine, and raised farm production to new levels. Some forty years later a new triumph was to come, for the terrible potato blight which had devastated Ireland and inflicted untold misery upon thousands of her peasants was finally brought under control, and has never since been a serious menace. This has been followed by the gradual control of many of the insect and fungus pests that had done so much damage on the farm.

Some twenty years later came the third triumph, when Bateson, studying the laws of heredity, rediscovered the work of Mendel, which had lain buried for over forty years, and attracted a group of enthusiastic workers to plant genetics, which has since greatly added to the resources of the farmer by providing him with new varieties of crops, but still more by providing the plant breeder with a set of principles that enable him within limits to build up new varieties almost to specification. Finally, there comes the latest achievement of fixing gaseous nitrogen from the air and converting it into fertilizers, thus securing indefinitely large amounts of those most important substances for the future.

Perhaps the simplest way of summing up the achievements of science in agriculture is to compare the prediction of Sir William Crookes in 1898 with the accomplishments of agriculture today. Speaking with a full knowledge of science as it was then, he predicted that the world in 1931 would require 90 million tons of wheat to feed its population, but that *unless science discovered new methods* this represented the utmost that the wheat growers of the world could do; afterwards the world would be faced with starvation. The accuracy of his forecast in regard to consumption shows how carefully he had made his calculation: the world does, as he predicted, require in 1928 about 90 to 100 million tons of wheat. But science has advanced so much as to upset altogether his calculations about the possible production. The 90 millions which he thought was the limit without new methods had been much exceeded even in 1911, and could be considerably exceeded today if it were needed. The fear of world starvation has gone, the achievements of science are only at their beginning, and there remains ample scope for patrons of science and for the patient efforts of the quiet scientific worker.

In spite of these brilliant successes agriculture is not prosperous, and, as Mr. Hewison points out, it suffers even in those countries where science is most diligently applied to it. It would, however, be fallacious to attribute the suffering in agriculture directly to the progress of science. The application of science to agriculture is not an isolated phenomenon: science is being applied also to industry, and whenever this happens production increases. Industries like the motor industry that have developed seductive selling agencies and played on the idea of "obsolescence" so successfully that the possessor of a perfectly good car feels bound to scrap it because a newer model has come out—these industries have remained prosperous. So also, but to a less extent, have those branches of agriculture that have followed the same methods: setting up good selling agencies and presenting goods in an attractive form to wheedle money out of a hesitating purchaser—such as some of the branches of market garden-ing, fruit and dairy production. But where salesmanship is less effective the industry has languished: science has shown the way to greater production, but there has been no corresponding growth in demand; men have been thrown out of work and producers have been unable to sell their goods. It is difficult to see the remedy: there is always a tail-end in every body of men, whether workers or producers, and every advancement of science makes it less necessary to employ these people, so that they tend to be left unneeded. It is part of the cost of the inevitable forward march of science, and although some solution may some day be found, none is yet in sight.

Science, therefore, cannot cure all ills of agriculture or of modern civilization, particularly those arising out of its very success in increasing production per acre and per man, and in dispensing with the less efficient worker and producer: indeed, as science advances the efficiency line will be drawn higher and higher, and an increasing proportion of people will fall below it, unwanted and unemployable. What is to become of them is a social problem outside the scope of this paper.

So far as cotton is concerned, science can unquestionably increase the output per acre and per man, and also reduce the wastes and losses of the growing crop from diseases and pests: it can thus enable the crop to be sold more cheaply, or in the alternative it can give the grower a larger return. Within limits it can develop new cottons, combining the desirable features of older sorts. These objects are still important, and so long as they remain so there will be need for scientific work.

This work is of two kinds, roughly classified in simple language as gaining information, and using it: in official language as fundamental or pure science, and applied science, but the distinction is not sharp. The chemical and botanical work that revealed the food of plants was pure science—the gaining of information: the experiments made with the foods, which when manufactured were called artificial fertilizers, are applied science—the using of the information. Without the pure science there would be no applied science. Until the information is obtained it cannot be used. If we are to make further advances corresponding with the great ones already described, it will only be after more advances in pure science.

Although the distinction between pure and applied science is not sharp so far as the subject-matter is concerned, there are clear-cut distinctions in practice. Pure science is concerned with general principles: applied science with solutions of particular problems. Pure science must be as exact as possible: applied science is satisfied if the figure is "near enough" or the method "generally works." From the practical point of view the most important difference is that pure science can be studied anywhere, while the application must usually be made on the spot. This is important for two reasons: modern scientific work is very costly, requiring elaborate apparatus, a multiplicity of books and journals, and, most important of all, ready access to other scientific workers with whom the investigator may discuss his problems from day to day, and gain useful help and constructive criticism. An isolated research institute, however large and varied its staff, and however rich its library and equipments, is never large enough, and the workers always need access to larger libraries, meetings of scientific societies, demonstrations and exhibits of scientific apparatus or methods, and lectures by men of the highest rank in their respective subjects. These requirements make it easier to do fundamental work at home than in most parts of the Empire, for wherever in England the research worker happens to be, he usually has two or three Universities within 50 or 100 miles, and he can always attend lectures, meet fellow-workers, obtain books from libraries, or see and try new forms of apparatus at very little expenditure of time. This is not the only advantage of doing the fundamental work at home: Mr. Hewison has pointed out the great difference in length of working life of a man in the tropics and at home: indeed, he suggests—and in view of his experience no one will lightly quarrel with him—that the man at home should achieve at least four times as much as the man in the tropics.

In research work, however, the obviously advantageous course is not necessarily the best, for the research worker is apt to be an elusive person conforming to no rules whatsoever: and in point of fact, some very good fundamental work has been and no doubt will continue to be done in tropical conditions where everything seemed unfavourable. For purposes of organization, however, it remains generally true that the home institution has the advantage when it comes to fundamental work.

In practice it is rarely possible to dissociate the pure from the applied science, there being, as already pointed out, no logical distinction between them. For many, if not most, of the problems by which the field expert is troubled, the underlying principles are not properly known, and until they are the problem cannot be solved: a rough working solution may be found, but it will always be liable to break down. The logical course would be for the field expert himself to tackle the matter fully, but as he has probably already got far more work than he can manage, he finds this impossible. It would be a great advantage if he could farm out the fundamental part of the investigation and himself do only what must be done on the spot, and yet remain in close touch with the fundamental investigator, so as to utilize fully all the information obtained.

The simplest way of discovering how far this kind of collaboration is possible is to try the experiment and see how it works. We are making the attempt at Rothamsted, but as we cannot afford wasted efforts, the work is being so arranged that it must still give valuable fundamental information, even if it does not link up as easily as we hope with the requirements of the man in the field.

Three attempts are being made. Agricultural investigators are well aware that field experiments, simple as they appear to non-experts, rarely give clear-cut results. So long as only single plots are used a result may seem to emergo, but the figures are apt to be very confusing if the plots are duplicated or, better still, replicated several times. We periodically receive at Rothamsted a pile of data obtained in field experiments, obviously made with care, which seem to be wholly unintelligible. The trouble arises from several causes: from irregularities in the seed, the soil and watering, the cultivation, and the incidence of diseases and pests. Of these, irregularities in the seed can often be minimized by the use of a pure line; cultivation of experimental plots may be made more uniform than over whole fields, while the incidence of disease, if it cannot be regulated, can at least be recorded. There remain the irregularities of soil and water distribution, which may escape not only control but even recognition. These have recently been studied at Rothamsted by the Statistical Department, and methods have been devised for casting out their effects. The methods are not easily reduced to rule, and in the hands of inexpert people may prove treacherous, but they can easily be applied by any mathematically trained person who knows something of statistical theory.

Fortunately this kind of work need not be done on the spot. If the worker can state in writing what field experiment he wishes to make, and can attach thereto some of the records of previous field experiments showing the kind of results usually obtained, the Rothamsted Statistical Department can draw up specimen plans of the field experiment from which the agriculturist can select the one best suited for field operations. Then when the results are to hand, the Rothamsted Department can inform the experimenter of their probable value and of the deductions that can safely be drawn from them, as well as the indications or suggestions not fully significant but yet deserving of further examination.

This kind of service can already be rendered by the home institute to the tropical worker, and it has the advantage of securing the maximum value from the field experiments in the minimum of time without the necessity for setting up a costly statistical department on the spot, which would be justified only if there were sufficient work for a trained man, aided by skilled computers and efficient calculating machines.

A more difficult group of subjects is also being studied in the Physical and Chemical Departments at Rothamsted with considerable promise of a successful issue. It is well known that irrigation may cause considerable soil deterioration, and that schemes attractive from the political and engineering points of view may, after a time, break down in practice. The soil chemistry of the older textbooks had no explanation to offer; certain new conceptions of the nature of clay are, however, proving much more helpful. In a normal fertile soil the clay is a complex compound of which the basic part is mainly calcium, and the acid part is an alumino-silicic acid: clay can indeed be likened to a calcium salt. Under irrigation conditions the calcium may be displaced by sodium, giving a sodium clay altogether different from the calcium clay, not suited to the same crops nor amenable to the same or, indeed, any known treatment. The conditions determining the formation of the sodium clay, its properties, and its reaction to water and to salts, are being studied in the laboratory, in order to give full information to the man who is trying to solve the field problem. Further difficulties arise from the salts usually present in any dry area where irrigation is desirable: they act on the plant both directly and indirectly through their effects on the soil, influencing its growth, its reaction to parasitic organisms or diseases, and to seasonal factors. These problems can be disentangled from the local field problem and studied separately: the information when passed back to the field worker cannot fail to help him in finding some way round his difficulties.

The third direction in which attempts are being made to help the tropical worker is in the study of plant diseases. Of these there can be no end, because new crops and new conditions may change a hitherto blameless organism into a serious pest, and once a disease begins it sooner or later spreads widely, thanks to our efficient modern transport. The Imperial Bureaux of Mycology and of Entomology have already rendered valuable service in the spreading of the news, telling the field experts what to look out for, locating the present situation of the disease, and reporting on control measures so far tried. They also examine and identify fungi and insects sent in to them. They do not, however, themselves conduct researches into the relationship of the parasite and the host plant, though the Bureau of Entomology has a laboratory for the breeding of parasites of insect pests.

Two attempts are now being made at Rothamsted to go further than this. Mr. R. H. Stoughton is working in conjunction with Major Archibald and Mr. R. E. Massey in the Sudan on the angular leaf-spot type of the Black Arm Disease of cotton caused by *Bacterium malvacearum.** Mr. Stoughton has set up miniature glasshouses in which cotton is growing under any desired conditions of temperature, humidity, and light. Everything is controlled electrically: a slight rise in temperature or humidity at once sets the correcting mechanism going to put things right once more: the electric sun is made to rise at six and to set at six automatically. Clean, strong cotton plants are grown right through to seed formation: indeed, seed free from any taint of disease has been raised here and sent out to the Sudan. Some of the plants are deliberately infected with the disease-producing organism, and its development in the tissues is studied; the relationships of soil and air temperature, water-supply in the soil, humidity of the atmosphere, and other factors to its progress are also fully investigated. The information thus obtained will, of course, be checked in the Sudan, but already it appears likely to save a lot of work there by discriminating between the paths which will probably lead somewhere, and those that will not. As all investigators know, much of the time spent in applied research is taken up in following the wrong track, and it is exceedingly helpful to be put on the probably right one straight away. Naturally the work has to be done cautiously, but Mr. Stoughton has had considerable tropical experience and is in frequent communication with the Sudan workers.

The other investigation to be made is into the nature of the virus diseases of plants: this is being done by Dr. J. Henderson Smith, who will be assisted by a cytologist, a plant physiologist, and an entomologist. These diseases are very serious already: they are spreading throughout the Empire, and the agent that causes them has not yet been discovered, so that they cannot be dealt with. If the agent is an organism it is so small that it passes through filters, and it cannot be grown on any medium yet tried. Two diseases can combine to produce a third different from either. Dr. Henderson Smith will first try to analyze the diseases and to obtain all information possible about the virus causing each. This work could hardly be done in the tropics: it will be costly and slow enough in England with men working all their time under favourable conditions, and with abundant equipment.

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* Cf. Abstract 89 on p. 86 below.

Up to the present our experience leads me to be hopeful about the future. With the speeding-up of communications between all parts of the Empire and England there is arising a spirit of co-operation between agricultural workers overseas and those at home: this has been fostered by the grants made by the Empire Cotton Growing Corporation to certain home institutions, Rothamsted among others, thereby securing centres where experts in cotton-growing can be sure of a welcome and a sympathetic discussion of their problems. Further, the development of scientific appliances enables the investigator to reproduce conditions for growth with an accuracy and certainty unattainable twenty years ago. The home institution can therefore go much further than has hitherto been possible towards lightening the task of the man in the field by providing him with precise information obtained under temperature and moisture conditions identical with his own. It is impossible to say how far this co-operation may lead: for the present we cordially invite the field experts to visit Rothamsted whenever they are home, and to see how far any information obtained or obtainable here is likely to help them.

Received November, 1928.

COTTON DISEASES IN UGANDA, 1926-1928

BY

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Government Mycologist.

PART I

I. SORE SHIN (*Rhizoctonia solani*, KUHN; *Corticium vagum*, B. ET C.).

THIS disease attacks the young seedlings at the time they emerge from the soil, causing a considerable loss under some conditions. The seedlings show a collapse and softening of the cortical tissues of the hypocotyls just about soil level, and at first usually confined to one side. Under very favourable conditions a large proportion of the attacked seedlings afterwards recover from the disease, the tissues affected drying out and leaving a brown scar on the hypocotyl. If weather conditions are unfavourable to the growth of the seedlings the disease progresses in the hypocotyl until the whole of the tissues at ground level are rotten, and the seedling falls over and dies. In Uganda this occurs both in cool wet weather, and also in dry periods such as prevailed during most of the planting season of 1927, when some of the experimental plots on the Government Plantation, Kampala, had to be replanted two or three times.

From affected seedlings the following fungi have been isolated in Uganda: *Rhizoctonia solani*, Kuhn, *Fusarium moniliforme*, Sheld., another sp. of *Fusarium*, 2 spp. of *Verticillium*, and a small nematode worm. *Rhizopus nigricans* often occurs on seedlings in a late stage of the disease.

Inoculation experiments were carried out with *Rhizoctonia*, *Fusarium*, and *Rhizopus nigricans*. About 200-250 c.c. of an agar medium made up with Sachs' water culture solution was placed in each of a number of litre flasks, and these were plugged and sterilized. Into each flask was then placed a seed of cotton, completely delinted with sulphuric acid and with all fuzz scraped off, and afterwards washed repeatedly with sterile water. The majority of these seeds produced sterile seedlings, though others, referred to later under seed infections, gave cultures of various fungi.

Into the sterile flasks about two days after the appearance of the cotyledons, cultures of each of the above fungi were introduced, with the result that in those flasks inoculated with *Rhizoctonia* every seedling became more or less completely rotten during the course of ten to fourteen days, whereas those inoculated with *Fusarium* remained healthy.

A second series of experiments was carried out, using pots of sterilized soil. These, after planting the delinted seed, were kept under bell jars and watered occasionally. The inoculation with *Rhizoctonia* and *Fusarium* into the soil was carried out at the time of planting. Twenty pots were used for each experiment, and of those inoculated with *Rhizoctonia* some 80 per cent. were completely rotten after a period of sixteen days, while no cases of disease were found in the other series.

The above experiments indicate that *Rhizoctonia solani* is the cause of this disease in Uganda, as was found by Briton-Jones in Egypt.

In young cultures the fungus hyphæ are hyaline and vacuolate, of varying diameter, and much branched. The general appearance of cultures varies considerably. In some cultures little or no aerial growth takes place, while in others a yellowish-white to buff-coloured aerial mycelium is developed in tufts up to 10 mm. in diameter. In older cultures the hyphæ turn buff and then reddish-brown in colour, with thicker walls and more frequent septa. Some aggregates of hyphæ become divided by septa into short, wide, barrel-shaped cells 10-20 μ in diameter which easily separate from each other. This is the first stage in the development of the sclerotia.

Young sclerotia have a whitish mealy appearance, due to an external layer of hyaline hyphæ, which are more or less collapsed and often devoid of cell contents. Inside a compact mass of brown hyphæ develops, each consisting of short barrel-shaped cells. When allowed to dry out the sclerotia become very hard, and a deep brown in colour, varying from 1 to 10 or more millimetres in diameter on different media.

During the very dry planting season of 1927 this disease, as stated above, caused considerable loss of seedlings on the Government Plantation, Kampala. Owing to the continued hot, dry weather, the growth of the seedlings was slow, and when once attacked by the fungus they appeared to be unable to throw it off. During the same period the fungus was found to cause great damage in the coffee seed beds on the same plantation. These were shaded from the sun, and kept watered. The coffee seed had been planted rather thickly, so that the seedlings were somewhat congested. Under these conditions the fungus spread very rapidly, and eventually killed out whole beds.

In Egypt Briton-Jones advises that the disease on cotton be dealt with by good cultivation, aiming at the maximum desiccation and maximum soil temperature with fine tilth. Under Uganda conditions it would appear doubtful whether desiccation of the soil is effective as a factor limiting the extent of the disease. In normal years the soil will not dry out to the same extent as during the very dry planting season of 1927, and then the disease was quite serious in extent. It would appear from the very limited field observations so far made in Uganda that between the very dry conditions prevailing in the cotton plots during the 1927 planting season, and the overcrowded, damp, cool conditions of the coffee nursery beds, a set of optimum moisture and temperature conditions may exist for the development of seedlings, enabling them either to resist or to throw off the disease.

In the native cotton plants, beyond good cultivation and preparation of the soil before planting, very little can be done to control the disease.

II. ANGULAR LEAF SPOT (*Bacterium malvacearum*, E. F. S.).

The disease causes small round or oval spots on the cotyledons of cotton seedlings, at first appearing dark-green and translucent, afterwards turning a dark-purple and then drying out. In the later stages they are often infected with various saprophytic and semi-parasitic fungi. In the early stages, when the weather conditions are sufficiently moist, the spots are covered with a yellow slime, consisting of bacteria.

On the leaves of older plants the spots are limited by the veins of the leaves and therefore present an angular shape, whence the common name of the disease. The spots on individual leaves may be few or many, but rarely are the leaves killed by the disease. In very wet weather the disease may attack the petiole and then kill the leaf.

In other cotton-growing countries this form of the disease on the leaves is not considered of any importance, but the disease also attacks the branches of the plant, and in this way is said to cause considerable damage to the crop, by killing off the branches with the attached bolls and leaves. In Uganda up to the present it cannot be said that this " Black Arm " form of the disease is sufficiently common to cause great damage to the crop. Only one case has come to my attention in 1927, when after a severe hailstorm, followed by very wet weather, the disease did some damage on the Government Plantation, Serere. To what extent the disease could be held responsible is doubtful, as the cotton plants were much broken and scarred by the hail.

Elsewhere cases of Black Arm are very occasional in cotton plots in Uganda, although the "Leaf Spot" form of the disease is quite common all over the country.

The attack of this disease on cotton bolls is discussed in Part II. of this paper.

From affected leaves the causal organism was isolated, and used for inoculation experiments. Snowden (*Circ.* 17, Uganda Department Agriculture, 1926) found that when sprayed on to healthy leaves kept under very moist conditions for about two days, infection readily took place through the stomata. Similar results have been obtained by the present writer. On the other hand, plants sprayed with a suspension of the bacterium, and kept in the open air during June-September, 1927, showed no signs of the disease. The spraying was repeated during this period several times, but with no result. Evidently under the dry conditions then prevailing the bacterium was unable to cause infection on unwounded leaves. When leaves were first pricked with a needle, or the epidermis injured in any way, it was found that under the same conditions infection readily took place.

In the course of experiments aiming at producing the Black Arm form of the disease on small twigs of the plants, it was found that during the period May-December, 1927, no infections at all took place when bacteria were sprayed on to the branches, even when the latter were very young. On the other hand, infection took place in approximately 80 per cent. of inoculations where the tissues were wounded with a needle or otherwise damaged.

All evidence available in Uganda, both from field observations and from experimental inoculations, indicates that this disease is not at present of any great economic importance, and does not occur to any serious extent except following periods of wet, cool weather. The Black Arm form seems to be entirely dependent on injury to the tissues of the stems for its development on Uganda cotton.

The disease is carried in cotton seed, both on the outside and internally. In the course of one experiment some cotton seeds were delinted with sulphuric acid, and the fuzz entirely scraped away, then again treated for some minutes in the acid, and finally washed repeatedly in sterile water. These were planted in flasks containing sterile agar made up with Sachs' water culture solution, with the object of obtaining sterile seedlings for inoculation purposes. Two of these seeds developed spots of *B. malvacearum* on the cotyledons as they emerged from the seed coat.

Other seeds from the same sample were then examined, and in some cases sections cut from discoloured spots on the cotyledons inside similar spots gave in one or two instances yellow bacteria capable of causing Angular Leaf Spot, but in most cases (about 80 per cent.) the yellow bacteria isolated from inside cotton seeds proved unable to cause this disease. These bacteria are discussed in detail later, and are quite different from *B. malvacearum* in their pathology and physiology.

There is no doubt that *B. malvacearum* does occur in Uganda inside cotton seed, as has been proved to be the case in other countries (Archibald, *Soil Science*, 23, p. 5, 1927). The extent of this internal infection is, however, usually very small, and a much more general method of dissemination of the disease is in the lint and fuzz on the exterior of the seed. This is quite commonly infected with the disease, and in the U.S.A. it is recommended that cotton seed be delinted with sulphuric acid before planting, in order to obviate this by sterilizing the outside of the seed. In Uganda such a procedure is financially almost impossible, and under present conditions the total damage due to all forms of disease caused by *B. malvacearum* does not warrant any expense in control, except possibly in dealing with the production and increase of new varieties of seed on Serere Plantation.

While discussing the dissemination of the disease by cotton seed, both externally and internally, it is of interest to note that one plot of cotton planted at Kampala from seed obtained from Serere in 1927 germinated with from 5 to 7 per cent. of infection by this disease on the cotyledons. During the long dry period which followed, the disease remained on some plants and died out on others without spreading on to the new leaves. In most cases the plants still infected were covered with aphis, and it is possible that the disease may have been carried up the plant by these insects in the absence of rain. Eventually, however, almost the whole infection disappeared, only occasional spots being found on the mature plants in the plot. Thus, although the seed undoubtedly carried the infection into the plot, and some of the seedlings were infected, the disease proved unable to make any headway during this dry year, and eventually almost died out.

I am indebted to the Cotton Botanist, Mr. G. W. Nye, for the information that strains of Egyptian and Sea Island cotton grown at Serere have suffered very badly from Angular Leaf Spot and Black Arm, and from his general observations he concludes that smooth-leaved varieties of cotton are more susceptible to attack by *B. malvacearum* than the hairy varieties.

The same correspondent is also of opinion that *B. malvacearum* is more important as a disease-producing organism in Uganda than the writer has indicated above.

III. "Areolate Mildew" (*Ramularia areola*, Atk.).

The fungus *Ramularia areola*, Atk. is of very common occurrence in Uganda, causing the "areolate mildew" disease. The spots are rather larger than those caused by *B. malvacearum*, and not so translucent. Eventually they often turn a bright red-brown in colour, and are covered with a white layer of the conidiophores and spores of the fungus. As a rule occasional infection of the disease can always be found in cotton plots in Uganda, but in rainy periods the amount of infection increases rapidly and may cause a partial shedding of the foliage on plants growing in shade. The actual damage to the crop is difficult to estimate, but appears to be insignificant.

IV. Other Leaf Diseases in Uganda.

Other fungi known to occur on cotton leaves in Uganda are *Mycosphaerella gossypina* with a *Septoria* as its imperfect stage, and *Alternaria longipedicellata*, Reichert. These cause Leaf Spot diseases, but under normal conditions are of no practical importance. *Alternaria* has, in exceptional instances, been noted as causing defoliation of individual plants, but other factors were operating to cause general ill-health of these plants.

V. Root Rot of Mature Plants.

From time to time mature cotton plants have been found dying off, and presenting symptoms of root disease. During the very dry season 1927-28, in some cotton plots on the Government Plantation, Kampala, such plants were quite common. No evidence is available at present to indicate whether or not the disease is of more general distribution in the Protectorate. The plants drop their leaves and wither up, the bolls drying up while still immature. The cortical tissues of the stem around ground level and of the roots are diseased, and filled with minute black sclerotia. These in culture give *Rhizoctonia bataticola*, but of a different type from that found on hosts such as coffee, shade trees, etc. In culture the form from cotton has given very much smaller sclerotia than the form isolated from various trees. It is possible that we have in Uganda at least two distinct forms or species of this fungus, and at present the systematics of *Rhizoctonia* here are being investigated, with a view to determining the host range of each form.

In other countries where this fungus is known to attack cotton it has been found that it is difficult to reproduce the disease by inoculation, and investigators in India, Egypt, and Trinidad agree in the opinion that the disease is dependent largely on external conditions which have not yet been determined. In Uganda the plants attacked are sporadic in occurrence through affected plots, and plants adjacent to those killed by the disease often show no sign of it.

VI. "FUSARIUM" WILT DISEASE.

From time to time wilted cotton plants have been examined in the laboratory, and in most cases, but by no means in all, a fungus has been found inside the wood of the lower parts of the stem and the roots. In culture this fungus corresponds to *Fusarium vasinfectum*, described in the U.S.A., Egypt, and in India as the cause of the disease. As far as India is concerned there is at present some doubt as to whether this fungus actually causes the disease, or whether the wilted appearance is due primarily to soil factors, and the fungus merely a secondary effect. In Uganda the same holds true, for, as above indicated, the *Fusarium* is not constant in occurrence in wilted plants. In one plot during 1926–7 season a considerable proportion of the plants showed more or less sudden wilting, dropping most of their leaves. Subsequently the larger part of these plants recovered from the wilting and developed a more or less normal foliage again. This could hardly have happened had the disease been entirely due to the *Fusarium* found in some of these plants. The problem of this *Fusarium* wilt disease is further complicated by the great difficulty of recognizing species of this group in culture. Saprophytic and parasitic species show no morphological differences (Hansford, *Kew Bull.*, 1926, p. 257), and in the present instance inoculation experiments have been consistently unsuccessful.

VII. INTERNAL BOLL ROT (*Nematospora gossypii*, ASHBY AND NOWELL).

This disease probably causes greater loss of crop in Uganda than any other. After the opening of the bolls, the lint of infected locks appears yellow in colour and forms the bulk of the " stained " cotton in the ginneries. Before opening the bolls appear quite healthy as a rule, though where young bolls become infected one or more locks often fail to develop normally, giving a lopsided appearance to the mature boll. No external injuries or disease symptoms are apparent, though the whole of the lint of the boll may be affected. Over 80 per cent. of all " Internal Boll Rot " in Uganda is due to *Nemato-*

spora gossypii, which may, or may not be accompanied by bacteria and other fungi. Other organisms found associated with the disease in Uganda are dealt with later.

In the field the proportion of bolls attacked is usually very small until towards the end of the season, when the final pickings may be almost 100 per cent. infected. In one experiment in which a plot of cotton was allowed to remain after the end of the season, a fair crop of bolls was produced in April–May, but every boll showed infection by this fungus.

Unopened bolls attacked by this fungus show a yellow to yellowish-brown discoloration of the lint, and the fibres are easily broken. The extent of each infection varies from a small patch of a few millimetres in diameter to the entire contents of one or more locks. Examination of young infections shows the presence of fungus hyphæ in the lint, ramifying between the individual fibres. The vegetative hyphæ of the fungus are at first non-septate and frequently dichotomous, with dense protoplasmic contents. The hyphæ are multinucleate about 2·5 μ in diameter. At a later stage these hyphæ become segmented by transverse septa into long barrel-shaped cells, 70-100 μ long by 8-13 μ in diameter. In each of these cells a number of spores are formed, usually twelve, arranged in two bundles of six, one at each end of the sporangium. Each spore is needle-shaped, with a filamentous appendage on the end towards the middle of the sporangium. These appendages are intertwined in the middle of the sporangium and vary from 50-100 μ in length, the spores themselves measuring 25-30 × 2-2·5 μ. When the spores are mature the walls of the sporangium degenerate, liberating them.

In culture the fungus grows rather slowly, and is on that account not easy to isolate in pure cultures free from the bacteria which often accompany it in the bolls. It forms a moist gelatinous layer on the surface of agar media and potato plugs. In liquid broth cultures growth is entirely submerged and consists of spherical colonies of branched non-septate hyphæ. Sporangia and spores do not appear to be formed in such liquid cultures, and over a period of two to three months growth remains entirely vegetative in character and the colonies do not multiply in number.

On agar media the septation of the vegetative hyphæ takes place more rapidly than in nature, with the result that the cultures consist almost entirely of the barrel-shaped sporangia in every stage of development with short lengths of vegetative hyphæ at the edges of the colony. The sporangial walls soon break up, leaving the groups of spores along the lines of the original hyphæ.

All isolations of the fungus in Uganda, both from cotton and from other hosts, are extremely uniform in all characters.

Pathogenicity : Inoculations.—In one series twenty-five bolls were sprayed with a suspension of *Nematospora* spores. It may be remarked that the preparation of a good suspension of these spores is practically impossible, as they float on the surface of the water and adhere in groups, owing to the non-wetting of the spore walls mentioned by Ashby and Nowell (*Ann. Bot.*, xl., p. 78). After a period of three weeks the bolls were collected and examined. Approximately 50 per cent. of the bolls were found to have been punctured by cotton stainers (*Dysdercus* spp.*) as indicated by the proliferations on the internal surface of the boll walls. All sites of these punctures were found to be infected with *Nematospora*, but apart from those no infection occurred.

A control series of bolls treated in a similar way, but protected from stainers in a mosquito gauze cage, showed no infection. These experiments indicate that the fungus is unable to penetrate through uninjured boll walls.

A series of fifty bolls sprayed with *Nematospora* and then pricked with a fine needle over the surface, developed no infections during the following period of three to four weeks before being collected for examination.

A similar series of fifty bolls pricked with a needle over the surface and then sprayed with the fungus also developed no infection.

A series of fifty bolls sprayed with *Nematospora* and then pricked with a very fine needle penetrating through the boll wall, developed 45 per cent. infection. A proliferation of the internal tissues of the boll walls occurred in the series, similar to that caused by the attack of *Dysdercus*.

A series of fifty bolls inoculated with *Nematospora* by means of a hypodermic syringe into the lock cavity gave 100 per cent. of infection.

From the evidence accumulated in experimental inoculation experiments in Uganda, which agrees with the results of Laycock (*Ann. Bull. Dept. Agric. Nigeria*, iv., 37, 1925), it would appear that infection by this fungus occurs only when the boll wall is punctured, leaving a passage for the entry of the fungus into the lint cavity. Whether or not it is able to grow through such a passage, or must be actually introduced into the lint cavities, still remains a doubtful point. The evidence indicates that the fungus cannot grow through the boll walls, even when these are superficially injured.

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* The species of *Dysdercus* known to occur in Uganda are the following:

D nigrofasciatus, Stal.
D. fasciatus, Sig.
D superstitiosus, Fab
D cardinalis, Gerst

The experimental work in connection with *Nematospora* in Uganda has been carried out with the first two species only.

When very young bolls are inoculated with *Nematospora* a very large percentage are shed. The shed bolls show infection by the fungus, with other organisms present in addition, presumably having entered through the comparatively large hole caused by the hypodermic needle used for inoculation.

Nematospora in Relation to Insects.—The close relation in the field between insects of the genus *Dysdercus* and the "Internal Boll Disease" of cotton was demonstrated by Nowell in the West Indies (*W.I.M.*, xvi., p. 203; xvii., p. 1). This relation exists also in Uganda. In repeated series of experiments these "cotton stainers" have been placed on healthy bolls in bags for a period of twelve to twenty-four hours, and the bolls examined after an incubation period of fourteen to twenty-one days. In such bolls from 30 to 100 per cent. of the total number of insect punctures were found to be infected with *Nematospora.* During the wet season of 1926–7 the percentage of infection in punctured bolls ranged from 75 to 100, while in repetitions of these experiments carried out in 1927–8 only 30 per cent. of infection was obtained in this dry year. The only explanation apparent is that in some way or other moist weather increases the percentage of infected punctures, and that the reverse is the case during a dry spell. This percentage of infection is to be distinguished from any effect of dry weather on the number of stainers, which in the field is found to be much smaller during a dry cotton season than in normal seasons.

In the present instance the actual percentage infection associated with equal numbers of insect punctures is shown to be considerably smaller during a dry season, so that the effect of dry weather on the occurrence of the "Internal Boll Rot" in the field is twofold, primarily to reduce considerably the actual numbers of insects present in the cotton fields, and secondarily to reduce the amount of infection caused by the insects present.

In the field examination of apparently healthy unopened bolls reveals that *Nematospora* infections in all but a few exceptional instances bear the closest relation to the punctures of *Dysdercus.* In a very small percentage of attacked bolls the infection commences from the base of the boll, where the boll walls are thin and soft, and these exceptions to the general rule are most probably to be associated with the attacks of certain other insects, which are able to penetrate the boll walls in this area, but not higher up where the walls are both thicker and tougher.

Apart from these few exceptional cases, it may be stated that *Nematospora* is practically never found in Uganda in bolls which do not show the puncture marks of *Dysdercus*.

When weather conditions are favourable, as in the season 1926–7, these insects are almost 100 per cent. efficient as inoculating agents with *Nematospora*, and even under unfavourable conditions wild stainers in the field introduce *Nematospora* into about 30 per cent. of all bolls punctured (in experiments in 1927–8 season). Comparing these facts with the results of artificial inoculations it is evident that these insects are comparable as inoculating agents with the hypodermic syringe, as far as results are concerned. Under favourable weather conditions the insects are much more efficient than a simple needle, even though the latter may penetrate inside the boll cavity. Where bolls are sprayed with *Nematospora* and then pricked with a fine needle, as a rule about 50 per cent. of infection results. If the spraying is carried out subsequently to the pricking with the needle, only occasional infections result. In the first case it is evident that the needle may carry some of the spores through the boll wall, but in the latter case this is not possible and the difference in results may be thus explained.

The cotton stainer is, however, a more efficient vector of the disease than an ordinary needle, even when *Nematospora* is sprayed over the boll with the latter. To account for the efficiency of the insect two theories seem to the writer to be possible explanations:

(*a*) That the fungus is of very common occurrence on the exterior of cotton bolls.

(*b*) That the insect actually transmits the disease from boll to boll.

The former of these " explanations " requires that the boll surface be practically covered with a layer of the fungus, for under favourable weather conditions practically every insect puncture is infected with *Nematospora*. If the insect merely makes a small hole through the boll wall and subsequently the fungus grows through, a fine needle should give comparable results, which, however, is not the case. Again, the insect may actually carry spores of the fungus which originally happened to be on the boll surface down through the puncture made by its proboscis actually into the interior of the lint. Such a case, however, to explain the large percentage of infection taking place in favourable seasons, would necessitate the whole boll surface being covered with the fungus in some form or other, as the punctures are so minute.

If this were actually the case it should be very easy to demonstrate the presence of *Nematospora* in such a position in relation to the cotton boll. In repeated isolation series cultures taken from the external surface of cotton bolls have given the writer only colonies of a large number of saprophytic fungi, belonging chiefly to the following genera: *Cladosporium, Macrosporium, Alternaria, Monilia, Fusarium, Oospora.* No culture of *Nematospora* has been isolated by the writer from such a position. It is possible that the very slow growth of *Nematospora* was masked by the other fungi found present, but the theory outlined above requires that the fungi shall be in such quantity on the bolls that it could hardly be overlooked. Also, spraying cotton bolls with *Nematospora* before inoculating with *Dysdercus* results in no appreciable increase in the percentage infection in either unfavourable or favourable seasons.

It appears to the writer that in view of the consideration outlined above the theory that the fungus occurs in quantity on the exterior of the boll, and is merely pushed in by the insect, is hardly tenable, and that on that account we are driven to the second theory—namely, that in some way or other the insect actually transports the fungus from boll to boll.

Evidence in support of the association of *Nematospora* with *Dysdercus* rather than with cotton is obtained from the known distribution of the fungus. In Uganda it has been found only in the interior of cotton bolls and seed, inside the seed of *Hibiscus esculentus* and of *Abutilon* sp. and inside the seed of Avocado (*Persea gratissima*). The latter case was not associated with *Dysdercus* and at present no evidence as to how the fungus entered the seed of this plant is available. Several distinct occurrences in Avocado seed have been discovered during the last two years in Uganda. With this exception the cases of *Nematospora* infection on plants other than cotton in Uganda have all been associated with infestation by *Dysdercus*. In the case of *Hibiscus esculentus* no evidence of the presence of the fungus on the exterior of the fruit was found in repeated culture series.

In an attempt to elucidate the relation between *Nematospora* and *Dysdercus* the following experiments were carried out with individual insects. The results are not as clear as one would wish, and the experiments will be repeated in the future. The writer considers, however, that the results indicate a close association of the fungus with the insect, and that the insect does actually carry the fungus from boll to boll. How the insect originally becomes "infective" and exactly in what manner it transfers the fungus from boll to boll are still left as open questions.

It may be that the insect feeds on a boll that is already infected and subsequently transfers spores of the fungus to a series of four or five bolls, by which time all spores remaining on the insect after its original feeding on the infected boll will have been removed.

During the coming season it is hoped to obtain further evidence on the transmission of Internal Boll Disease and its relation to cotton insects in Uganda other than *Dysdercus*.

(*See Tables on pp.* 23-26.)

INDIVIDUALS OF "DYSDERCUS NIGROFASCIATUS" WITH RELATION TO "NEMATOSPORA" INFECTION.

Series BA–BM : January 6–February 9, 1928.

Ten insects placed on cotton bolls, changed once every twenty-four hours (in the early morning) over a period of one month.

NOTE.—Several individuals died during the course of the work and were replaced by others. In the following remarks no notice has been taken of insects not living for more than five days.

No treatment was given the bolls before or after placing the insects on them.

From the table it appears that in no case is infection found in more than five successive bolls fed to an individual insect. The period intervening between successive series of infections varies. When only a single day intervenes it is possible that the insect may not have fed on that day, but a longer period has more significance. In one case there is a period of fifteen days between two "infective periods."

TABLE A.—*DYSDERCUS* IN RELATION TO *NEMATOSPORA*.

DAILY. SERIES BA–BM.

Days.	*Insect No.*																
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1.		×			×	×			×	×		×				×	
2.				×	×	×		×	×	×	×	×	×				
3.	×		×	×			×	×						×		×	
4.	×				×	×	×					×		×			
5.	×		×	×		×	×		×		×	×			(×)		
6.	×	×	×						×	×	×	×	×				(×)
7.		×	×		×	×		×	×	×	×						
8.	×	×		×	×	×				×		×					
9.		×	×	×		×											
10.					×						×				×		
11.					×	×											
12.			×														
13.						×											
14.						×									×		
15.																	
16.															×		
17.																	
18.															×		
19.																	
20.																	
21.																	
22.																	
23.																	
24.																	
25.				×													
26.				×													
27.				×													
28.				×													
29.				×													
30.																	
31.																	

: infections. (×) = infections probably extraneous.

Ignoring "non-infective" periods of a single day the largest number of successive infections in this series is 10, occurring once, and once 6.

Series BO–BZ : January 6–February 9, 1928.

The individual insects used were fed on bolls on successive days, changed once every twenty-four hours as in the preceding series, in the early morning, but in this series the bolls were first sprayed with formalin ½ per cent. aq. which was allowed to evaporate before placing the insects on the bolls. In the table (B), all insects living for less than seven days have been ignored.

In this series the largest number of successive infections is 5, or, ignoring periods of a single day, 7. In one case there is a period of 15 days during which no infection took place, and several other periods of 6-9 days of non-infection occur. In the case of four individuals no infection at all took place, over periods of 11, 12, 7, and 14 days respectively.

TABLE B.—*DYSDERCUS* IN RELATION TO *NEMATOSPORA*.

DAILY. BOLLS WASHED ½ PER CENT. FORMALIN.

Days.	*Insect No.*																	
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	13.	14.	15.	16.	17.	18.
1.												×		×	×			
2.													×					
3.	×									×			×	×				
4 .						×			×	×								
5.	×						×		×				×					
6.	×			×		×	×					×	×	×				×
7.				×		×					—	×			×		×	×
8.		×								—			×	×				×
9.		×		× —		× —			—			—		×			—	×
10.		×						×					×	×				×
11.			—															—
12.	×				—			×					×	× —	—			
13.	—	×																
14.		×														—		
15.																		
16.		—																
17.													—					
18.																		
19.																		
20.								—										
21.							—											
22.																		
23.																		
24.																		
25.																		
26.																		
27.																		
28.																		
29.																		
30.																		

× = infections.

Series EA–EM : January 24–February 9, 1928.

In this series the insects were changed to new bolls twice every day, early morning and at sunset. No treatment was given the bolls during the experiment.

The largest number of successive bolls infected was 5, or ignoring a twelve hour period, 7: ignoring a twenty-four hour period, 10.

Periods of " non-infection " greater than this vary from two days to six. Two individuals gave no infection over periods of six and five days respectively.

TABLE C.—*DYSDERCUS* IN RELATION TO *NEMATOSPORA*.

Twice Daily. Series EA–EM.

Days.	*Insect No*															
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1 M. ..																
E. ..		×	×			×	×		×							×
2 M. ..		×	×		×		×			×						×
E. ..	×						×									
3 M. ..		×	×				×	×		×			×			
E. ..	×					×	×									
4 M. ..													×			×
E. ..	×	×					×	×								
5 M. .		×				×										
E. ..		×	×		×		× —	×	—			—			—	
6 M. .														×		
E. ..			×		—											
7 M. ..	—	×		—						—				×		
E. ..						—		—								×
8 M. ..		×														
E. ..											×					
9 M.																×
E. ..		×											—			×
10 M. ..											×					
E. ..		× —														
11 M. ..											×					
E. ..											—			—		
12 M. ..			×													
E. ..			—													
13 M. ..																
E. ..																
14 M. ..																
E. ..																×
15 M. ..																
E. ..																×
16 M. ..																—

× = infections.

Series EO–EZ.

The bolls were changed twice daily as in the preceding series, but were washed with ½ per cent. formalin before feeding to the insects, and the solution allowed to dry.

The largest number of successive bolls infected was 4; ignoring a twelve hour period, 8; ignoring a twenty-four hour period, 8.

Periods of "non-infection" greater than this vary from thirty-six hours to four days. One individual gave no infection at all, for a period of five days.

TABLE D.—*DYSDERCUS* IN RELATION TO *NEMATOSPORA*.

TWICE DAILY. EO–EZ: WASHED ½ PER CENT. FORMALIN.

Days.	Insect No.														
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1 M. ..												×			
E. ..											×				
2 M. ..		×	×	×		×			×	×	×		×	×	×
E. ..	×									×					
3 M. ..	×			×						×	×		×	×	
E. ..	×	×		×	×										
4 M. ..			×									×		×	
E. ..	×		×		×					×			×		×
5 M. ..				×			×		×	—		×	—	×	
E. ..		×	× —					—			×			×	
6 M. ..	×	—							×		×	×			×
E. ..						×					×	×			
7 M. ..	×			×		×			×			×		×	
E. ..				×	×				×		×	×		—	
8 M. ..				×	×	×	×				×				×
E. ..											—	×			
9 M. ..				—	×	×									
E. ..						—	×					× —			×
10 M. ..									×						
E. ..	—				—				—						×
11 M. ..							×								
E. ..							×								
12 M. ..															×
E. ..							—								
13 M. ..															×
E. ..															
14 M. ..															×
E. ..															
15 M. ..															
E. ..															
16 M. ..															—

× = infections.

(To be continued.)

MAARAD COTTON

BY

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Origin of Name.—It was considered appropriate that this new variety of cotton, which was produced by the Technical Section of the Royal Agricultural Society of Egypt, should be given the name of Maarad, which in Arabic means "Exhibition," the title by which the Royal Agricultural Society is generally known to the Egyptian public, on account of the Agricultural and Industrial Exhibitions it has held in the past. A new name was given to this cotton to avoid confusion with the American Pima in the spinning factories, and to demonstrate that it was produced by selection and acclimatization and not simply by importing seed from America.

History.—In 1918 and 1919, at the request of the late Mr. Victor M. Mosseri, Technical Adviser and Director of Agricultural Research to the Society, a small amount of American Pima seed was brought from Arizona.

Pima cotton itself, an Egyptian type grown in the south-western parts of the United States of America, is claimed to be the result of mutation, and was discovered and selected by Dr. T. H. Kearney, Physiologist of the Bureau of Plant Industry, U.S. Department of Agriculture. In 1901, seed of Mit Afifi cotton was imported into America and planted at Carlsbad, New Mexico. In 1906, individual selections made in Carlsbad in 1905 were planted at Yuma (Arizona). In 1908, after two years of selection, two among the progeny rows were totally different in type from the parent variety and from one another. One of these rows gave rise to the Yuma variety, which after several years' test, has been grown on a commercial scale in the Salt River Valley (Arizona). The Yuma variety shows a striking resemblance to the Egyptian Nubari, which appeared in Egypt three or four years earlier. In 1910 a single plant of marked individuality appeared in a field of the Yuma variety at Sacaton, Arizona, to which the Pima variety owes its origin. An excellent progeny row was grown in 1911 from this exceptional individual plant; selections were made in 1912 and in 1913, and a careful examination failed to reveal any noteworthy departure from the type of the variety among approximately 1,000 individuals in the progeny rows of this group. The substitution of Yuma by Pima, which is superior to any of the preceding varieties both in yield and fibre, took place from 1916 to 1919.

It has long been known that the cottons cultivated in Egypt have always shown deterioration as time passes, owing to causes whereof initial impurity of seed is the most important. This impurity is principally due to natural crossing which has taken and is still taking place. Such hybridization has occurred owing to the fact that different varieties of cotton have grown side by side, and seed containing a mixture of different varieties—which mixture may have occurred in the ginning factories or in the field—has been used for planting.

The object of the late Technical Adviser to the Royal Agricultural Society, assisted by the writer of this article, by Mr. W. J. Lugard and the Egyptian staff, has been to purify the existing Egyptian varieties of cotton before creating new varieties by crossing. At the same time Pima seed was brought from America, because Pima, having been cultivated in its country of origin, protected from environmental influences, and from mixture in the ginning factories, or by other means, should be a pure variety.

It was realized that Pima as it existed in America was inferior in quality to Sakellaridis in this country, which is of the same type; but it was considered that pedigree selection, in which advantage would be taken of the variations which might occur under the new environmental conditions of soil, water, and climate in the Egyptian Delta, would not take long to correct the undesirable characters of Pima, and that by careful selection the purity and desired qualities would be obtained.

The first Pima seed which arrived in 1918 was planted in experimental rows at the Experimental Farm at Bahtim. In 1919, a second lot of seed from 38 bolls picked from different plants was brought from Arizona and planted out in the pure-line breeding field at the Society's Farm at Dukki, near Cairo. The fact that several separate lines were obtained later from these bolls indicates that the original stock was not as pure as had been premised. Pedigree selection was carried out during the following years, as a result of which several pure strains have been produced that have not yet been propagated on a large scale, because some other strains appeared sufficiently homogeneous to justify their tentative multiplication and propagation. These latter strains were produced from 100 individual selections which were planted at Bata Experimental Farm in 1921. In 1922, 1923, and 1924 further selections were made from the plant-row families and increase plots obtained. By studying the yield and field records and selecting only those which gave the best yield combined with the most satisfactory gradings, best field reports earliness, vegetative growth, regularity in height, types of plants, statistical records, etc., the number of strains was considerably reduced in 1925, when seed sufficient to sow 700 feddans* was distributed to cultivators in five different provinces in the Delta, and the average yield obtained was 5 kantars† per feddan, against about 3½ kantars of Sakel.

In 1926, 4,500 feddans were cultivated in forty different localities spread over six Moudiriehs in Lower Egypt. The average yield obtained was 4½ kantars per feddan, which compared favourably with that of Sakel, which in the same localities gave 3 to 3½ kantars.

Last year, 1927, over 4,000 ardebs‡ of seed were distributed to sixty-four cultivators in Lower Egypt on 110 farms, and the total area sown was 12,500 feddans. The yield was again satisfactory, being 1 kantar per feddan more than Sakel grown in the same districts. This increase yield of Maarad is considered to be due to the following reasons:

(1) Better fruiting development and more bolls per fruiting branch.

(2) Axillary bolls are not shed to the same extent as in Sakel.

(3) Heavier weight per boll.

(4) It gives a bigger first picking, and is not relatively so badly attacked by Pink Bollworm.

Other advantages of Maarad over Sakel are that it is longer in lint length (41 mm. to 42 mm. halo length), gives a higher ginning outturn, and has less "Skerto"§ and "Mabrooma."§

RESULTS OF COMMERCIAL COTTON VARIETY TEST CARRIED OUT BY THE MINISTRY OF AGRICULTURE.

Since 1925, Maarad cotton has been included in the Commercial Cotton Variety Tests carried out by the Agronomic Section of the Ministry of Agriculture, and in 1928 was used as one of the central varieties in six of the Botanical Section's chequer plots. These tests, which are carried out in a very efficient manner, are made in seven to ten different districts in the Delta, spread over the various Moudiriehs, and the varieties grown include the existing cottons and any new strains which it is considered may be of interest and of use to Egypt. The varieties of cotton included in these tests besides Maarad are:

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* One feddan equals 4,200 square metres (1·038 acre).

† One kantar equals 315 rotls seed cotton (100 rotls lint).

‡ One ardeb of cotton seed equals 120 kilos or 270 rotls (1 rotl=·99 lb.).

§ "Skerto" and "Mabrooma" mean cotton attacked by Pink Bollworm.

Fouadi, Pilion, Nahda, Casulli, Sakel Domains, No. 310, and Sakel Commercial. During the last three years in which Maarad cotton has been included, it has given a better yield of seed-cotton per feddan each year than any other variety.

A summary of the average yields per feddan in these tests during the last three years has been worked out with the following results:

Variety of Cotton.	*Kantars per Feddan.*				*Rank.*	*Other Varieties Compared with Sakel Standing at* 100.
	Average Yield.			*Three Year Average.*		
	1925.	1926.	1927.			
Maarad	5·90	5·89	4·30	5·36	1	130·4
Fouadi	5·49	5.77	4·27	5·17	2	125·8
Pilion	—	5·71	4·18	4·94	3	120·2
Nahda	5 39	5·37	3·81	4·85	4	118·0
Casulli	5·26	5·02	3·33	4·69	5	114·1
Sakel Domains ..	4·88	4·25	3·19	4·11	6	100·0
No. 310	4·80	4·45	3·05	4·10	7	99·7
Sakel Commercial	4·79	4·19	3·27	4·08	8	99·2

It will be seen that, compared with Domains Sakel—the best Sakel grown in the country—Maarad cotton in 1925 gave 20 per cent. better yield, in 1926, 39 per cent., and in 1927, 34 per cent., or an average superior yield over the three years of 30 per cent., which confirms the good yielding results of Maarad cotton grown on the commercial scale.

One of the most interesting features of these tests is that as one comes from the north to the south of the Delta, the superiority in yield of the Maarad over the Sakel becomes more obvious. In the North, from figures supplied by the Ministry of Agriculture, it is shown that there is an increase in favour of Maarad of 15 per cent.; in the Middle Delta 32 per cent.; and in the South up to as much as 50 per cent. From information received which has not yet been published, there is an indication that both from a yield and quality point of view this variety of cotton could be grown successfully even South of Cairo into the Middle Egypt region.

STEPS TAKEN TO KEEP UP THE STANDARD.

At each locality where strains of Maarad were planted from which seed for sowing was required, the fields were separated during picking into "cage" and "belt," the latter consisting of 8 to 10 kassabas* around the edge of the field. This separation was made to ensure as far as possible that cross-pollination with other varieties of cotton in the neighbourhood did not take place with the "cage" or centre part of the field. The cotton from the belt was ginned separately and the seed sent to be pressed into oil. The seed from the cage was used for planting next year.

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* One kassaba=3·55 metres.

Roguing.—Specially trained men were sent to each locality where Maarad strains were grown to rogue off-type plants which might have occurred.

Inspection.—Special attention was paid during inspections to see whether other varieties of cotton were present in the Maarad fields. One year, at the 4,000 feddans stage, about 25 per cent. of the area of Maarad cotton was found to be mixed with Sakel cotton, either from resowing with this variety or from "Okre Sakel plants." The fields found to be mixed were noted, and the seed from these areas was disposed of as "tugari"—*i.e.*, for pressing into oil. This illustrates the difficulty of keeping exact control of a variety in bulk on other people's land.

Ginning.—Great care was taken to prevent mixture with seeds of other varieties of cotton, also mixture of one strain with another during ginning. Before ginning commenced, the ginning factory was thoroughly cleaned and the cotton from the belt was always ginned previously to the cotton from the cage in each strain, cleaning of the factory also taking place between each ginning. The first few sacks from each "taqawi" ginning lot (seed for sowing) were discarded and put as "tugari." Before each strain was ginned, the seed cotton was examined in the factory store to see that no other variety of cotton was mixed with the Maarad.

Seed sufficient to sow 800 to 1,000 feddans was hand-picked by children. In this way we always have a renewal of a nucleus of selected seed which is as good as possible from a seed point of view. This seed is planted on 200 feddans at two experimental increase farms, and the remainder is distributed to cultivators who take great care in the cultivation of their cotton crop.

NEW STRAINS.

The several pure-line strains previously mentioned but which have not yet been propagated on a large scale, have been graded as having strength and lustre equal to that of Sakel, combined with the other characteristics of Maarad. From strain tests carried out at the experimental farms, their yields are better than the Commercial Maarad. Amongst these, M368, M33A and M10–403 are the most important. They have been botanically described, and each has proved to be of a distinct type, the latter strain being from a short plant selection quite different from anything else obtained from Maarad.

Interstrain crosses have been made between pure lines of Maarad, as well as crosses between Maarad and other Egyptian varieties, which seem to be promising.

The photographs show a typical Maarad plant, plants of a pure progeny, types of plants selected from Maarad cotton from which the above strains have been produced, a field of Maarad taken just before picking, and also Maarad cotton halo length compared with Sakel cotton halo length.

To facilitate the propagation of this new cotton, the Maarad Cotton Company was formed in 1926, consisting of several important cotton firms in Alexandria, which had the right to dispose of the lint, but the control of the seed remained with the Royal Agricultural Society. Last year it was arranged that Maarad cotton should be put on the open market, and any firm that wished to buy this variety from the cultivators could do so, and sell the lint to spinners abroad, on the condition that the seed was sold back to the Royal Agricultural Society for distribution the following year.

Commercial Value.—Since 1922 samples of Maarad have been submitted to the leading commercial houses and graders in Alexandria for their opinion with regard to its commercial value, and they have always considered that it is a fine, long, regular cotton with a good appearance, but it was thought that the strength was not equal to that of the best Sakels. The general opinion was that it was a desirable cotton, and if the yield was maintained, that it should be suitable both from the cultivators' and spinners' point of view. In 1925 samples of this variety were taken to Manchester and shown to spinners interested in fine cottons. They were without exception favourably disposed towards it, their only objection being that the price was too high at that time, but they considered that if it could be sold at the same price as Sakel, or slightly under Sakel, it would be taken up and become a commercial success.

Spinning tests have been carried out in England, on the Continent, and in America, which have been rather conflicting, as seems to be usually the case when a new variety of cotton is being tested. Some spinners in England said that they had made similar observations with Sakellaridis when it first came on to the market—viz., that the staple of that variety was longer at that time than at present, and

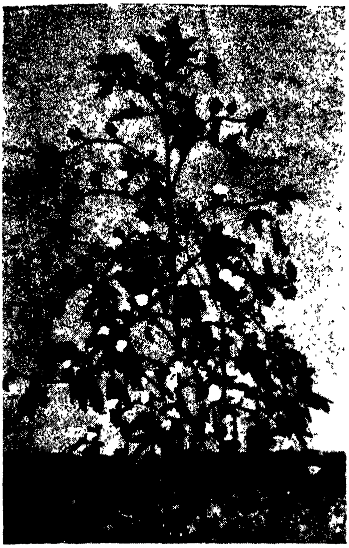


FIG. 1.—A TYPICAL MAARAD COTTON PLANT (ONE METRE SPACING).

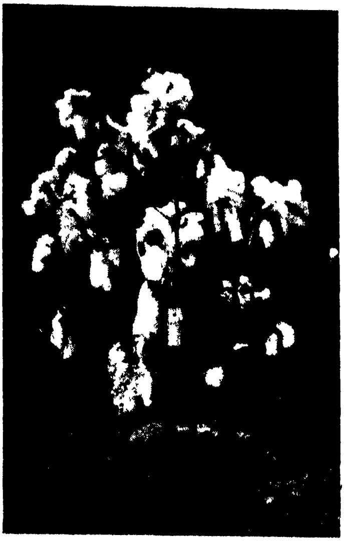
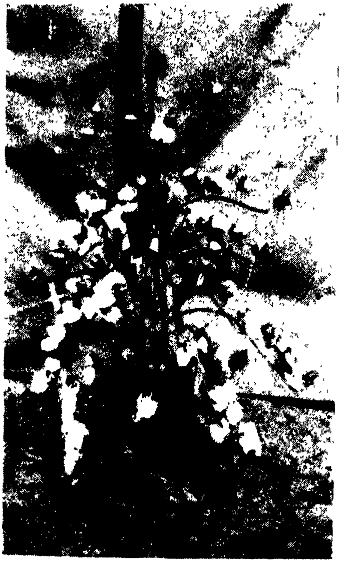
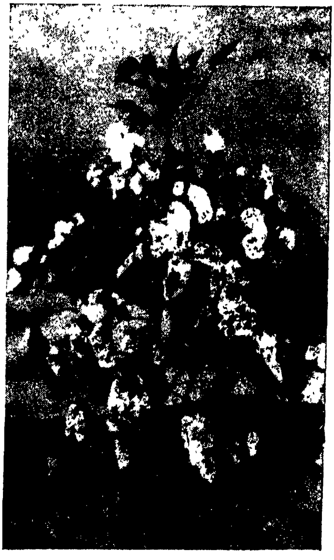


FIG. 3.—SHORT PLANT SELECTION (NEW TYPE SELECTED FROM MAARAD).





FIGS. 4 AND 5.—OTHER TYPES OF PLANTS FROM MAARAD COTTON.

Fig. 2—Plants of a Field [illegible] (One Metre Spacing)

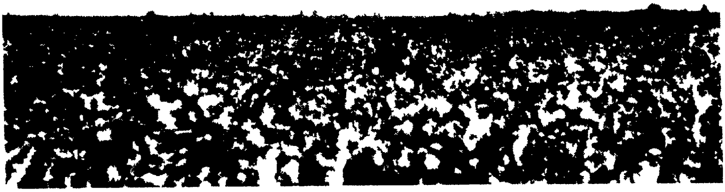


Fig. 6—Field of Maarad Cotton Ready for Picking

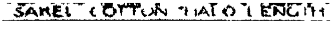


Fig. 7—Maarad [illegible] Hair Length

that it is essential in order not to damage the fibres that the beating on the scutchers should not be too hard, and on the subsequent machines, up to the intermediate frame, that the number of revolutions of the main-shaft should be reduced."

Every year the Fine Cotton Spinners' Experimental Department at Bollington has kindly carried out spinning tests on Maarad cotton, and the opinion given as a result of those tests has been that its strength per unit weight was not as good as the highest grade Sakels against which it was tested, with the two following exceptions: A commercial sample sent from the 1924 Maarad crop gave an extraordinarily high " hair strength for equal weight of hair " which was confirmed in the yarn tests, and in the following year in a report sent by the Fine Cotton Spinners to the Ministry of Agriculture on spinning tests of cottons grown in their cotton variety tests, it was shown that Maarad twist yarns were almost as strong as those of Domains Sakel " X," and that the outstanding feature of the whole tests was the high count/strength product in the Maarad weft spinning.

Reports received from other spinning factories in England have varied, statements having been received that the strength as well as the regularity in yarn was superior in Maarad to that in Sakel; on the other hand, less encouraging results have also been sent stating that yarn made of Maarad is not so strong as that from Sakel.

French and Swiss spinners state that it is as good as, if not better than, very fine Sakel.

Tests have been carried out by the United States Department of Agriculture, and their reports state that Maarad cotton is fine, unusually uniform, and has unusual strength. This was confirmed by tests carried out on behalf of the United States Department of Commerce, in which it is recorded that as far as strength is concerned, the spinning qualities of Maarad cotton are similar to the best American grown Pima of equal grade and length of staple.

On account of the conflicting spinning reports received, it was decided at the beginning of this year to send thirty bales of Maarad of each of the ten types to England to be tested at the Fine Cotton Spinners' Experimental Department and at other mills in the Manchester district where it could be spun in the ordinary way. The results have been received and the conclusion arrived at is that if Maarad could be obtained at a slight discount on Sakel it would be required by the spinners. It should be borne in mind, however, that it was spun from 80's to 100's in these factories, whereas Maarad has shown to good advantage when spun to higher counts.

On account of the increase in yield of Maarad over Sakel, it is considered that the cultivators in Egypt could sell it at a less premium than Sakel, with profit to themselves, thus meeting the requirements of both the spinners and cultivators.

Taking everything into consideration, especially the very good reports of the present year's yield which are now coming in from cultivators and the opinion of graders that the lint is stronger this year, it seems that the expectations of the late Victor M. Mosseri (whose name will always be closely associated with this variety of cotton) as expressed by him at the International Cotton Congress held in Egypt last year [illegible] advantage of Maarad would be to solve the Egyptian Cotton problem in implying simultaneously quality and quantity, and [illegible] the opinion of Dr. Lawrence Balls, who remarked in his paper on "New and Old Varieties of Cotton in Egypt" [illegible] Zurich this year [illegible] Maarad [illegible] on account of its yield, will [illegible]

(Part of the [illegible] International Congress Report of [illegible])

[illegible]

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MUSINGS IN A MONSOON CLIMATE

BY

W. YOUNGMAN,

Economic Botanist to Government, Central Provinces and Berar, India.

IT is night, and outside it is very dark, save for a glare from the lighted town four miles away. A slight breeze blows from off the Satpuras, a low range of hills forty miles to the north. The servants, all save the watchman, have gone to bed, and I am alone in the little bungalow surrounded by the fields of the holding, where are growing eighty acres of groundnut, a hundred and fifty of cotton, and twenty-five of the larger millet. Except for the cry of an owl and the soughing of the millet, all is quiet, for there comes no sound from the distant town. Eastern towns give forth no buzz of busy man, for the people are shoeless and the streets unpaved. It is the season of the monsoon, but the monsoon has but sparsely come, and deep cracks, wide enough to hold the cobras, have appeared in the fields. An old countryman told me this morning that it was like the last year of famine, 1896, when his family lost all their substance, and have been landless bondsmen ever since. Times were so hard, I was told, that for human sustenance the millet grain had then to be eked out with leaves of weeds, and there was little difference between the food of man and that of his domestic animals. The cultivator must always be weatherwise, and this temporary (let us hope but temporary) suspense in the monsoon leads me to muse upon the influence of the monsoon rainfall on agricultural practice. Before me are the meteorological records, and my note-books containing notes of many experiments.

This part of Central India is named Berar. It is a country of an ancient agriculture where man has practised husbandry for perhaps more than two thousand years, with but little or no application of manure to the land, and no systematic rotation of crops. The land has long ago reached a condition of minimum yield out of which only an extra favourable monsoon ever raises it. The importance then of the monsoon is tremendous; it and a few village gods are the only providences from which native humanity ever hopes for favours. Before the advent of the iron road the withholding of these favours meant famine. Nowadays death does not come with this failure, but hardship does. Ordinarily the rains begin seriously in the latter half of June, and continue intermittently until the beginning of October. As soon as they come the cultivator sows his cotton. In this period some thirty-two inches of rain usually fall upon the thirsty earth. Two independent harvest seasons result: that of the rains crops, planted at the advent of the monsoon and harvested say about Christmas, and that of the crops sown at the completion of the monsoon rains and harvested in the spring. Cotton, groundnut, and the millets are included in the former, and wheat and linseed in the latter.

The following table gives the rainfall and the yield of seed-cotton on the Government Farm, Akola, Berar, for the past twenty years.

Year.	*Rainfall in Inches.*										*Yield in Lbs. of Seed Cotton per Acre.*
	June.		*July.*		*August.*		*Total June to August.*	*September.*		*Total Rain-fall for the Year.*	
	1st Half.	*2nd Half*	*1st Half.*	*2nd Half.*	*1st Half.*	*2nd Half.*		*1st Half.*	*2nd Half.*		
1908–09	2·14	6·49	7·31	4·71	4·84	4·42	29·91	5·25	0·57	36·87	342
1909–10	2·34	2·66	4·28	2·33	4·16	2·57	18·34	2·80	3·11	30·85	504
1910–11	2·41	6·93	2·59	1·47	8·14	2·84	24·38	3·23	4·78	36·65	259
1911–12	2·62	0·15	6·32	1·78	5·48	1·62	17·97	0·42	2·59	23·85	570
1912–13	0·15	4·53	0·52	5·13	3·35	2·27	15·95	0·12	1·27	17·90	489
1913–14	2·06	4·90	2·62	7·36	1·99	1·31	20·24	5·47	1·22	27·49	509
1914–15	1·50	5·39	2·74	2·58	3·08	1·38	16·67	7·79	1·14	31·46	564
1915–16	—	5·25	0·45	9·76	1·13	1·46	18·05	2·92	0·20	29·11	682
1916–17	8·27	3·24	7·11	5·70	5·53	1·74	31·59	2·63	2·81	47·95	60
1917–18	5·52	2·56	1·82	4·01	0·41	5·88	20·20	4·36	5·29	36·69	179
1918–19	0·77	3·94	1·52	1·28	0·43	1·23	9·17	0·08	0·05	13·24	218
1919–20	1·93	6·00	2·56	4·83	0·59	2·07	17·98	0·61	3·99	25·30	771
1920–21	0·20	3·16	1·77	0·81	0·47	0·97	7·38	0·86	0·55	8·94	55
1921–22	1·19	3·94	1·55	5·95	4·50	0·17	17·30	0·85	4·56	24·82	513
1922–23	0·27	5·90	1·07	13·11	0·21	0·59	21·15	5·08	1·27	31·04	216
1923–24	1·23	0·80	2·71	6·84	1·22	0·76	13·56	3·72	5·66	24·70	454
1924–25	0·56	0·79	2·78	3·87	1·23	12·64	21·87	2·58	4·20	33·37	334
1925–26	4·11	1·96	0·77	2·17	4·00	3·13	16·14	0·57	1·28	23·65	393
1926–27	—	0·57	9·15	5·75	6·77	4·56	26·80	2·74	0·18	30·68	373
1927–28	1·20	5·69	5·27	2·37	0·85	0·63	16·01	0·01	7·23	31·75	782

It will be seen that it is the rain that falls in the first three months of the monsoon that really tells upon the yield of the cotton crop. From the table it would seem that thirteen to sixteen inches of rainfall, if well distributed throughout the first three months, and two or three inches in the fourth month, are sufficient to produce an average crop. There must be a sufficiency, but most important is the distribution of that amount. Observations upon the moisture contents of the soil show us that the real point of importance is that the percentage of water in the soil down to a depth of at least four feet should reach 25 per cent. as soon as possible after the time of mere germination of the seed, and remain so throughout the period of vegetative growth—that is (with us), for the months of July, August, and September.

During these months, which are the time of active growth, intermittent rainfall is also beneficial. Continuous drizzling rain, although amounting to the same quantity in the aggregate, is not favourable in that it reduces the soil temperature below the optimum for rapid growth of the plant. A very characteristic feature of monsoon climates is the great difference between the night and day temperatures. Many different functions of plants have their own peculiar range of temperature limits between which they actively proceed. In the plants of climates such as ours, then, some functions are ordinarily limited to the night-time and others to the day, and even to comparatively short periods of time of night or day. Anyone who has prepared and examined cotton-root tips for observation upon the cytology of their cells is aware of this. Root tips from soil that has been watered within an hour or so of their fixation will show the nuclei of the cells all in a resting condition. We were forcibly reminded of the importance of temperature on one occasion when microscopically examining living cotton hairs upon the seed coat. An unusual thunderstorm came on which reduced the temperature to 74° F., and we observed protoplasmic streaming taking place in the living cotton hairs, a phenomenon we had never seen before when the temperature had been higher. This seems to confirm the fact that they largely grow at night, which would be the only time when so low a temperature is ordinarily attained. The whole subject of water and temperature in their bearing upon the growth of the cotton plant is an uncharted sea in which the physiologist may sail, making discoveries upon every hand. His explorations, however, must be made under a tropical sky, and not in a greenhouse with a tub in a more congenial clime.

To return to our rainfall table, only once in the twenty years has the crop failed from excessive rain. In 1916–17 nearly forty-eight inches of rain sent the yield down to sixty pounds per acre. All the seasons in which thirty-three inches or more of rain fell have given yields below the average, and in connection with this the soil texture plays a part. Our "black cotton soil" is a stiff clay, and thirty-three inches or more of rain mean water-logging. On other soils this may not be so, nor might it be so with us on a hill slope; but usually our land is flat and does not present very good drainage facilities. In the neighbouring Central Provinces cotton grows well in an annual rainfall of forty-five inches. The American saying—"Cotton likes a hill"—is no doubt another way of expressing the dislike of the cotton plant for too much water at its roots.

It will also be seen from the table that only once during the period did our cotton crop fail owing to insufficient rain: in 1920–21 less than nine inches of water resulted in only fifty-five pounds of seed cotton per acre. In the year previous, a precipitation of only twenty-five odd inches gave the highest yield but one in the history of the farm, and 24·82 inches in the next year gave a yield well above the average.

At first it is enough that the soil keeps moist around the germinating seed and the advancing roots of the young seedling, but the sooner four to six inches of rain fall the safer. The greatest danger no doubt is a break in the rainfall for any length of time at the period of germination. If the seed start to burst and then become dry, death is certain. A wise man will notice bad germination and immediately resow. It is the "hope deferred" that so often results in a thin crop. Here, too, there are interesting discoveries to be made. Every variety of Asiatic cotton has its own range of specific quantity of water necessary to germinate its seed. The different varieties, and different strains of the same variety too, show each a characteristic property in the amount of water required for this purpose.

As a group the *herbaceum* cottons, of all Indian cottons, require the most water for germination, and the varieties of *Gossypium obtusifolium* require the least. In between these two extremes come the other varieties. The water requirement for germination is conveniently expressed as the average quantity of water (given as a percentage of the original weight of the dry seed) that is absorbed up to the time that the embryonic root tip first shows. Expressed in this way *herbaceum* cottons require 100-150 per cent., and *obtusifolium* cottons 50-70 per cent. The *Gossypium neglectum* group ranges between 80-100 per cent., and the same range also includes *Gossypium indicum*. *Gossypium arboreum* seeds require 60-90 per cent. of water.

There is no doubt that the water requirement of cotton seed for germination is a line along which natural selection has acted, fitting certain plants for certain habitats. It is a little observed phenomenon because not externally, nor patently, obvious. The ability of a seed to germinate with a reduced quantity of moisture is doubtless a property often continued into the later life of the plant as an ability of the plant to grow in a soil with a reduced moisture content. We have several interesting instances of this in our Indian cottons. There are certain cottons which ordinarily flourish in a tract in the cold weather season when little or no rain falls, whilst others, the more usual, do so in the monsoon period. Temperature no doubt as well as water requirements amongst other factors have been influences evolving these cottons. Amongst cottons, as well as amongst other plants, physiological strains often isolate themselves, the peculiarity of which is their germinating ability within a water requirement range differing from that of their ancestors.

Gossypium intermedium is an Indian variety which has the property of growing in the cold weather season, and ordinarily is not sown until about October.

In Berar, *Gossypium indicum*, when grown, is sown at the usual season and ripens its fruit at the same time as other cottons. In the southern corner of the neighbouring Central Provinces a "physiological race" of this cotton has isolated itself, and the seed of this is sown in October at the termination of the monsoon. It has of necessity a very short period for growth and reproduction. The water content of the soil at sowing time is some 25 per cent., and toward the beginning of March, when flowering and fruiting are taking place, it is approaching 15 per cent., falling to 10 per cent. by April, when the cotton is ripe. Only this "physiological race" of *Gossypium indicum* will grow and flourish in this tract at this season, and in consequence the crop has thus, of its own accord, maintained an unusual degree of purity for a field crop.

A comparatively low percentage of water required for the germination of a cotton seed is an advantage. The higher the percentage the longer must the seed take to absorb it, and the slower will it be in bursting its coat, and setting the young pent-up plant free. Slow germinating seeds are liable to suffer in several ways, especially from fungus attacks, for the delay allows the fungus to get the upper hand before the young plant gets a proper start in life.

The cotton plant's race for life is short and swift; it must fit its life span into the period of favourable rainfall conditions. As with a sprinter so with the cotton plant, the importance of a good start is a great thing. Selection of a crop for quick germination is easy and often attended with surprising results. Cotton seeds from the same plant of a "pure line," whose flowers have been protected from cross pollination, can be germinated on moist sacking or blotting paper, and all the early sprouting ones picked out and transferred to loose damp soil where they will grow into plants whose seeds are subjected to the same process again next season. Of course, all the progeny of single-selfed plants are kept separate; "mass selection" is of no value. In this way an early get-away characteristic can often be imparted to a crop.

Some cottons characteristically show low percentage of germination for which it is not easy to account. *Gossypium arboreum* has this character, and it imparts it to hybrids derived from it as an ancestor. The seed of the wild cotton *Gossypium Stocksii* is very difficult to germinate, perhaps owing to the imperviousness of its skin to water. A slight cut in the seed coat, or rubbing the seed on fine sand-paper, helps the appearance of root tip and cotyledons.

Directly connected with the monsoon is a problem that has not in India received the attention that it requires. This is the method and possibility of the application of fertilizers. The soil in India has been under a more or less continuous cultivation without fertilizers, manure, or sufficient rotation, for ages. The people are vegetarian, and there is no incentive to mixed farming where live-stock play their part with crops. In all but the larger towns, where wood and rarely coal are used, the droppings of the cattle constitute a meagre source of fuel. Cookery has developed along lines where such slowly combustible fuel is now made almost a necessity by the ancient customs of this domestic art. Little or no return of that which is removed is or can be made to the soil in the form of manure from animals. The immense importance of rotation cannot therefore be over-estimated. The usefulness of many fertilizers for the rains crops largely depends upon the method of their application. Although India is perhaps peculiar amongst all the agricultural lands of the world in her terrible state of soil exhaustion, her problems with regard to fertilizer application are shared with other monsoon climates. Heavy intermittent showers, such as generally characterize a monsoon climate, leach all soluble fertilizers out of the surface soil, and leave it robbed of nitrogen, after perhaps one shower; but it may have slightly recovered by natural nitrification before the next occurs. The problem in the application of artificial nitrogen compounds and other soluble chemicals is to avoid this leaching. Experiments indicate that it is to be met in one of two ways. The first method consists in deciding what kind of fertilizer it is advantageous to apply, and then experimenting in its method of application. It will certainly be found of greatest benefit in the monsoon period to add fertilizers in small quantities at a time rather than the whole amount at one application (especially is this the case with such readily soluble chemicals as sulphate of ammonia and nitrates of potash or soda).

One hundredweight of sulphate of ammonia, for instance, applied to an acre of cotton will nine times out of ten give the greatest benefit if applied in three or four doses. The first application should be preparatory to sowing, and the others in the period during which the plants are attaining their first foot or so of height. Even thus the element of luck is not entirely eliminated, for a heavy shower immediately after an application of the fertilizer may remove it out of immediate, or even of any, availability to the plant. However, one would indeed be unlucky if this were the fate of all the applications.

Experiments on our farm indicate that greater success in the use of fertilizers in a monsoon climate is to be attained along other lines of application than the above. These consist in the impregnation of some readily decomposable organic matter, itself of manurial value, with the soluble fertilizers. The principle is that the soluble salts first come into solution, perhaps, being more gradually yielded up from the organic material than if applied by themselves; and then the organic matter itself, by decomposition, gives up its constituents. The ill-effects of leaching are in this way entirely, or almost entirely, avoided. For the organic material oil cakes from local oil seed crushing mills are very suitable. Mostly we use castor seed cake, but cotton seed, groundnut seed, or any other seed cake will do. The chief point is to have an analysis of the cake made, and to decide from that and its cost whether its use be an economic proposition.

In addition to oil cakes all possible means are taken on the farm to utilize for manure organic material such as weeds, stalks, and roots cleared from the fields after, and during the time, they are bearing their crops. Too often this material is removed from the land and neglected. We transfer it to pits where it is brought into decomposition and conserved until required. Along with this material also go all the cotton stalks grown on the farm. Our average production of stalks after drying in the sun is about one ton per acre. Such stalks, according to chemical analysis, contain about 0·5 per cent. of nitrogen and 0·1 per cent. each of phosphoric acid and potash, in addition to carbonaceous matter, which is also advantageous. As soon as the cotton-picking is finished, which is about February, we pull or cut off the stalks. It is now the season when we are ginning our last cotton and starting to cut up our millet stalks into fodder for the cattle during the coming hot and dry months. We have spare power to cut up the cotton stalks also at a very low cost; they cut up very easily with almost any form of fodder cutter, for they are but little or no tougher than the millet. Actually we find the American pattern of fodder cutter, with horizontal knives around a central axis running in front of two feeding rollers, to be the best form for the work. It does not matter much how old the knives are; if the stalks be chewed up rather than cut up, all the better. With a machine with ten-inch-long knives we can cut up some two tons of stalks per day. The cut-up stalks are transferred to pits, twenty feet square and eight feet deep. The stalks are piled up squarely above the ground level for some four feet, so as to allow for settlement. It will be about March by the time that all this has been accomplished. The pits each contain some sixteen tons of stalks, and they are situated conveniently near a well so that water can be run into them to flood them. This flooding is done once a fortnight until the monsoon sets in. By about October all but the thickest portion of the stalk will have softened. Bacterial or chemical action takes place in the pits, for if their contents be dug into between the times of flooding they will be found quite warm. These softened stalks are now transferred at intervals to the general farm manure pits, where all the manure from the cattle stalls goes, and where their further decomposition takes place. The contents of these manure pits can be treated with any quantity of soluble fertilizer and applied to the land for the crop of the season that follows a year after they were placed in the pits. The compost thus made will gradually give up in the soil its own organic matter. In this way leaching is largely prevented and a valuable method of manuring under monsoon rainfall conditions obtained.

Amongst simple and fatalistic native cultivators a monsoon climate is itself an impediment to agricultural improvement. In a season of a weak monsoon no amount of manuring and cultivating the land will produce a bumper crop. The exceptional yield produced by an exceptionally favourable monsoon alone, on the other hand, is by itself such as to make a fatalistic community believe that Providence solely is to be waited upon, and the idea that rotation, a better variety of seed, manuring, and altered cultivation, will give a reward, is too often disregarded. This great dispensation of Providence in the shape of a favourable monsoon is not to be realized in a country where the average yield of crops is pushed near to a maximum; the great discrepancies between good and bad seasons never here exhibit themselves in agricultural yield to anything like the intensified extent that they do in a country where, like India, the greater part of the land is on the verge of its minimum yield. Where good cultivation and rotation are practised an exceptionally favourable season may produce an increased yield over that which a sound farmer is accustomed to expect, of some 50 per cent. perhaps, at the most; but in an area of farming where land is ordinarily producing its minimum yield there is a possibility of two- or three-fold average production due to a favourable season alone. What wonder then that the uneducated cultivator in a monsoon climate waits upon Providence to such an extent as he does! The great problem is to get him to see how to help himself.

I look up from my papers. It is already past midnight. Outside the rustling of the millet leaves in the breeze has ceased. I go out on to the verandah of the bungalow and find the watchman with his lantern has come into its shelter, for outside a gentle rain is falling and the sky is heavily beclouded. The monsoon *is* coming! The watchman is a man from the north of India, speaking the *lingua franca* that I know, and he tells me in the words that are so often used in connection with a beneficial rain—" Khudda kush hain." " The Almighty is pleased," and I, also pleased, retire to bed.

[By taking the range between extremes, the effect of wide rainfall variation from the mean climate can be very well seen in the table of rainfalls given. The average crop is 413 lbs. per acre. Dividing the twenty crops into four groups (0-200, 2-400, 4-600, 6-800 lbs.), and taking the ranges of the rainfall, we obtain the following table:

Number of Crops.	*Average Crop (Lbs.).*	*Range of Rainfall in—*		*Total.*
		June-August.	*September.*	
3	6-800	2 04	4·12	6·45
7	4-600	6·68	7·54	13·56
7	2-400	20·74	7·88	23·63
3	0-200	24·21	8·24	39·01

Mean rainfall of 20 years	28·72
Mean rainfall of 3 years of big crop	28·31

(Varying only from 25·30 to 31·75.)

ED.]

METHODS OF SELFING COTTON FLOWERS

It is customary in most experiment stations to prevent the cotton flowers from opening in order to insure self-fertilization. It is open to the worker to select the method he will employ from several alternative procedures, which include tying with string or with wire, slipping a wire noose over the bud, sewing the flower-bud with needle and thread, and bagging it with either gauze or paper.

In the hope that it might be helpful to members of our staff abroad to learn what advantages and disadvantages had been found in practice to be associated with the several kinds of technique enumerated above, the Corporation asked members of their staff to give details of their practice, stating the advantages which had led them to adopt it, and the disadvantages attaching to any other methods that they had tried. A summary of the replies received is published below, and it is hoped that by posting the information thus obtained, other workers in cotton experiment stations may find therein useful suggestions for improving their present practice, or may be able to inform their fellow-workers, through the Corporation, of any means whereby the disadvantages experienced with any particular method of selfing may possibly be overcome.

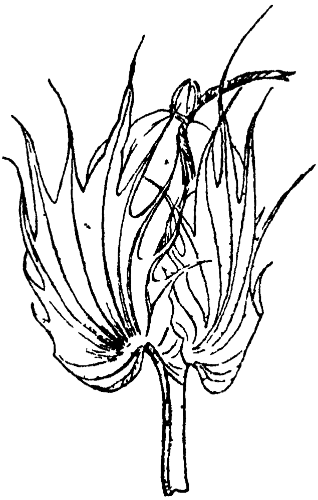
The Corporation wish to extend their hearty thanks to all those who have, at considerable trouble, given detailed accounts of the methods of self-fertilization of cotton flowers employed by them, and the reasons that have led them to adopt any particular technique.

TYING THE BUDS.

This method has the advantages of cheapness, speed, and simplicity. The end of the unopened flower-bud is closed by means of either string, wire, wool, or a rubber band. In some countries this can be done on the morning on which the flower will open, while in others there is not time then in bright weather, and the process has to be completed on the previous afternoon. The buds are tied about ¼ inch below the apex, care being taken that the petals are not cut through in the process. Later in the day, or on the following day, the selfed flowers are tagged with wool or coloured cloth tied to the flower-stalk.

In Southern Rhodesia an experiment is being made with a small vulcanite clip as a means of closing the ends of the petals, while in Nyasaland an attempt is being made with a quick-drying gum. If successful, this latter method recommends itself by reason of its simplicity and cheapness. The gum is contained in a small bottle, the end of which is just large enough to admit the tip of the flower-bud, which is moistened by tilting the bottle. This method also involves the minimum amount of handling of the plant. Inspection of the treated flowers on the following day, when they should be due to open, shows those which are successfully selfed. These are then marked by a coloured tag.

Below is a sketch of a flower-bud which has been self-fertilized by tying with string.



WIRING.

In this method soft copper wire is cut into suitable lengths, then twisted into spirals and a spiral slipped over the bud on the evening before it opens, or early in the morning of the same day. Care must be taken not to bind the wire too tightly round the petals, so as to avoid risk of cutting them through as the bud expands. A small loop is made at the lower end of the wire and a piece of very fine fishing cord attached to it; this is tied to the fruiting branch close to the peduncle and acts as a label. The wire spirals can, of course, be used repeatedly, and if the cord is dipped in oil before use, it also will last many seasons. The cost of material is given as being about 4s. 6d. for 1,000 buds.

STITCHING.

An ordinary needle and thread are used. The needle is run several times through the tip of the bud about ¼ inch below the apex for American types, and a little slack is left between the bud and the bract to allow the former to elongate without tearing out the cotton. If a record is wanted of the date of selfing, a label can be threaded on the thread: in a very moist climate it is advisable to dip the label in melted paraffin wax after writing on it. The work goes on throughout the day, and it is not necessary to confine it to buds that are certain to open on the following day. Those buds which are sewn two days before they would open are found to set quite satisfactorily. In these younger buds the stigma is sometimes pierced by the needle, but this does not appear to affect the setting.

With a properly sewn bud, the corolla swells out below at opening time, but remains well closed. After setting, the corolla falls off and hangs by the thread to the bract, thus labelling the boll.

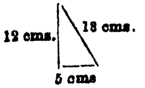
An examination is made at intervals of a few days to a week, and all properly selfed bolls are marked by tying a piece of coloured wool round the peduncle. It is most important to be able to check the work easily and certainly, and this method therefore possesses a great advantage in that the effect cannot be faked, since a corolla which has once opened and has been tied up again can be readily detected. The plant is generally affected slightly by the handling and trampling, but this cannot be avoided, and the setting is on the whole as good as with untouched flowers, though there appears to be a tendency for selfed bolls to be very slightly lighter than unselfed.

In South Africa it has been found that native labour does stitching of flowers better than tying with cotton or wool. Under Nyasaland conditions, on the other hand, the stitching method has been found to cause more damage to the flowers through handling than does tying them with wool or soft tobacco twine.

BAGGING OR NETTING.

The practice of enclosing the flowers in bags or nets is used in many countries. It is claimed that when the work has to be done by native labour this method is safer than tying or wiring the flowers. Further, nets show up plainly on the cotton plots, which facilitates checking. Their initial cost is naturally higher than wire, but they can be used repeatedly, adherent pollen being destroyed by stirring up the nets in boiling water after removal from the plants. Netting takes longer than wiring or tying, but by making the nets cone-shaped it is claimed that they can be pulled over the flowers very quickly without damage; the open end is then secured by twisting a small piece of soft aluminium wire once round the flower-stalk.

It may be of interest to include here details of the cost of material in the Sudan. The cone-shaped nets have the dimensions shown:



Fine sandfly netting costs in Khartoum 1s. 11d. a yard, and fifty bags can be made from one yard. The cost of sewing works out at 16s. per 1,000 bags, so that their total cost is £2 15s. per 1,000. The wire used is No. 22 w.g. aluminium wire, of which 350 feet, costing 1s., is sufficient for 1,000 bags. Mr. Bailey reports that during the season 1927-28 he used 3,000 bags, by means of which about 37,000 flowers were selfed in three months by a staff of six to eight small boys. The proportion of selfed flowers that set was about 95 per cent.

Whether bags are used or not must naturally depend among other things on the readiness with which they can be made locally. To overcome this difficulty in Nyasaland Mr. Ducker has used an 8-inch square of netting converted into a bag by means of a small rubber ring which grips the gauze and the flower-stalk. This gave satisfactory results, save for the fact that in the rainy season the bags must not be left on more than a few days on account of the marked tendency for bolls thus treated to suffer from boll rot.

When it is possible to leave the bags on the plant from pollination until the opening of the boll, they afford in addition protection against attacks by bollworms which injure buds and bolls, as well as against boring beetles and stainers, which will cause damage to bolls at all stages.

The following details of routine practice supplied by Mr. Bailey, the Corporation's Plant Breeder in the Sudan, may be of general interest, though they may not be found to be generally applicable, or to commend themselves without modification to workers elsewhere. Nets are placed over buds the day before the latter are due to open (judged by size); they are left on until the third day, when they are removed, dropped into boiling water and spread out to dry. In order to be able to tell at a glance which bags are due for removal three colours are used: blue bags are put on on Saturdays and Tuesdays (removed on Tuesdays and Saturdays), white bags are put on on Sundays and Wednesdays (removed on Wednesdays and Sundays), yellow bags are put on on Mondays and Thursdays (removed on Thursdays and Mondays). Friday is a holiday for labour in the Sudan. At the time of removal of the nets a note is made of all flowers which have failed to set, and a small dated label is tied round the stalk of all that have set satisfactorily.

In a note on bagging by Kearney and Porter which appeared in the *Journal of Heredity*, an account is given of experiments in which paper bags were used instead of nets. This method was found to be more successful with Egyptian than with Upland varieties: with the latter varieties wiring or tying caused less shedding than did the use of bags.

When bags are employed, these are slit at the side so that they can be placed astride the fruiting branch carrying the bud, and are closed tightly beneath the branch by a loop in a piece of wire. It has been observed that selfed flowers produced by bagging produce only about 80 per cent. of the number of seeds that are formed in naturally pollinated flowers. The less complete fertilization of the bagged flowers is doubtless due to the fact that under this condition pollen reaches only that part of the stigma which is in contact with or immediately above the uppermost anthers. Examination of the pistils in flowers thus enclosed shows to what a narrow zone the pollen grains are restricted. In unenclosed flowers, on the other hand, bees and other pollinating insects carry pollen to all parts of the stigmatic surface soon after the corolla has expanded. Bagged flowers are better fertilized when the whole surface of the stigmas is covered with pollen by hand than when the pollen is confined to the basal portion.

When using different coloured paper bags to enable those due for removal on any day to be picked out readily, it has been noted that flowers enclosed in brown bags were not so well fertilized as those in white bags. This has been attributed to the absorption of heat by the brown bag, raising the temperature of the enclosed flower to a degree unfavourable to fertilization. No significant difference was found in respect of degree of fertilization when using white bags of different thicknesses and glaze.

At the Plant Breeding Station at Barberton, Transvaal, Mr. Parnell is testing the efficiency of thin paper squares such as are used for wrapping oranges. A very light tissue paper used for crossing work has been found successful in surviving several heavy rains. Mr. Parnell points out, however, that a disadvantage attaching to the use of bags, as compared with tying the buds, is the difficulty of checking the work in order to avoid the possibility of opened flowers having been enclosed.

In thus summarizing the information which members of the Corporation's staff have been good enough to supply, and that obtained from the note by Messrs. Kearney and Porter describing the experiments at the U.S. Field Station, Sacaton, Arizona, the Corporation venture to express the hope that those who have thus enabled this article to be compiled will not find that any vital detail of the practice described has been omitted or incorrectly rendered. It should be understood that no one method is here recommended as superior to others, but, on the contrary, it is hoped that those interested may find in this summary suggestions that may be of service to them in their work.

SOME RESULTS OBTAINED FROM THE SULPHURIC ACID TREATMENT OF COTTON SEED

BY

G. W. NYE,

Cotton Botanist, Serere, Uganda.

In view of the report by Professor Blackman on germination studies of the sulphuric acid treatment of cotton seed (*vide E.C.G. Review*, Vol. V., No. 3) it may be of interest to summarize some of the results which have been obtained from this seed treatment in Uganda.

The tests were commenced in 1926 on a small scale in the laboratory, and the following results were obtained:

Treatment.	*Percentage Germination.*	*Days to Complete Germination.*
Control (no treatment)	63·5	10
Watersoaked for 10 minutes	55	9
Con. H_2SO_4 „ 5 „	76	4
„ „ „ 10 „	81	4
„ „ „ 15 „	83·5	6
„ „ „ 20 „	96	4

These results show a definite increase both in percentage and in rapidity of germination due to acid treatment. The tests were conducted in petri dishes and germination counts were made daily; in the case of treated seed, the seed was washed in several changes of water for twenty minutes. In conjunction with the above a subsidiary test was carried out on the germinating power of seed which floated on the surface of the washing waters, which gave the results tabulated below:

Treatment.	*Percentage Germination.*
H_2SO_4 for 5 minutes	32
„ „ 10 „	33
„ „ 15 „	50
„ „ 20 „	76

The floating seed consists to a large extent of dead and weakly seeds. It is very noticeable in all tests that the germination of floating seed is very much less vigorous.

In 1927 the test was repeated on a modified scale, and the increase in percentage and rapidity of germination was again very marked:

Treatment.	*Percentage Germination.*	*Days to Complete Germination.*
Control	61	10
Watersoaked for 20 minutes	72	5
Con. H_2SO_4 for 20 minutes (floating seed)	78·5	5
Con. H_2SO_4 for 20 minutes	88·9	4
Con. H_2SO_4 for 20 minutes (seed treated and sun dried several days before the test)	83·9	4

In view of the success of this treatment it was deemed essential to carry out a small field test to ascertain whether there was any after effect deleterious or otherwise from acid treatment. On July 23, four rows each of forty plants were sown of each of the following treatments plus a control, only one seed being sown per hole:

Control	No treatment.
Watersoaked	Seed soaked in water for 20 minutes immediately previous to sowing.
H_2SO_4 (A)	Seed treated with acid for 20 minutes some weeks previous to sowing, washed in water and dried, sown dry.
H_2SO_4 (B)	Seed treated with acid for 20 minutes, immediately previous to sowing, washed in water and sown wet.
H_2SO_4 (C)	Similar to H_2SO_4 (B) but seed taken from surface of liquid.

Germination of treated seed was very rapid, and plants appeared above the ground three days before control.

The percentage germination of acid-treated seed, treatment B gave a significant increase over the control, and over treatments A and C; the figures are given in the table below.

Weekly growth and daily flowering records were kept throughout the season; the acid-treated seed showed more rapid growth for the first fortnight after germination, but after this the rate of growth was the same for all variates. The total yields of cotton per row showed very much in favour of acid-treated rows, on account of the much better stand, as no resowing had been done. The cotton from all treatments was examined in the laboratory, and no differences at all were observed for either qualitative or quantitative characters.

Table showing results from field trial:

Treatment.	*Percentage Germination.*	*Mean Yield per Row in Grams.*	*Lint Length.*	*Ginning Outturn.*	*Lint Index.*
Control	51·7	2,883	32·15	33·9	5·5
Watersoaked ..	62·4	3,408	32·91	34·0	5·6
H_2SO_4 (A)	54·5	3,058	32·33	32·0	5·0
H_2SO_4 (B)	70·8	4,097	32·65	33·0	5·5
H_2SO_4 (C)	55·4	3,333	32·37	34·5	5·7

CONCLUSIONS.

The increase in germination percentage and rapidity of germination under laboratory conditions for treated seed is thus confirmed in a small field trial.

The acid treatment of seed has no visible effect on the after-growth of the cotton plant, and none on the produce of the plants.

This treatment has useful possibilities in ensuring good germination when only small quantities of seed are available; it might also find application in certain field trials where resowings are objectionable.

The sterilizing* benefits are well known, but an additional advantage of this treatment is that in the removal of the floating seed most dead and weakly seeds are got rid of and a nearly perfect stand can be obtained.

Some of the above results have already appeared in the Corporation's "Annual Reports from Experiment Stations."

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* According to the Director of the Wellcome Tropical Research Laboratories, Khartoum, sulphuric acid treatment will not completely sterilize Black Arm-infested seed, but appears beneficial because it delays the manifestations of the disease in the cotton plant (Archibald, "Sulphuric Acid Treatment of Cotton Seed," *Soil Science*, xxiii., 1, 1927).—ED.

THIRD REPORT ON COTTON MANURIAL EXPERIMENTS IN THE UNION OF SOUTH AFRICA, SEASON 1927-28

We have received from Mr. Pieter Koch, Principal Field Husbandry Officer, Department of Agriculture, Pretoria, a copy of the Third Report on Cotton Manurial Experiments in South Africa. This is a continuation of the work described in the Second Report, a summary of which appeared in Vol. V., p. 165, of this Review.

The amount of detail contained in the Report renders it too lengthy to publish in full, and the following summary is therefore included showing the results of the work carried out to date.

TRANSVAAL MIDDLE VELD.

(1) *Rustenburg* (*Government Tobacco and Cotton Station*).—Fertilizers applied as before, and 40 lbs. of seed per acre drilled in on November 2, 1927, spaced 4 to 8 inches apart. Rainfall was more or less normal in total. The manured plots showed a great advance on the check plots, the plants being 18 to 24 inches high against 8 inches. The table given below shows the great difference in yield.

Superphosphate.	*Average Yield of Four Plots in Lbs. per Acre.*
100 lbs. per acre.	249·1 lb.
200 „ „ „	506·5 „
400 „ „ „	576·2 „
Checks	90·1 „

Corresponding figures for the use of basic slag:

Basic Slag.	*Average Yield of Four Plots in Lbs. per Acre.*
128 lbs. per acre.	343·1 lb.
256 „ „ „	553·1 „
512 „ „ „	566·9 „
Checks	72·7 „

The residual value plots, which received dressings as far back as 1925-26, also showed great additional yields, rock phosphate being better than slag.

(2) *Zoutpansberg District.*—(i.) *Una Farm:* Planted October 29, 1927. The crop suffered badly from drought. Yields, though low,

again show considerably in favour of the manured plots, the following increases being recorded:

Superphosphate.	*Increase in Lbs. per Acre over Check Plots.*
100 lbs. per acre.	58·5 lbs.
200 " " "	46·2 "
400 " " "	58·1 "

Basic Slag.	*Increase in Lbs. per Acre over Check Plots.*
128 lbs. per acre.	38·8 lbs.
256 " " "	41·2 "
512 " " "	29·3 "

(ii.) *Townlands Farm:* Planted October 26, 1927. Drought at the wrong time spoiled the experiment, though it was noticed that the residual slag and rock phosphate plots were superior to others.

TRANSVAAL EASTERN LOW VELD.

Pietersburg.—Platveld Farm: The rain after the planting on October 22, 1927, was so heavy that the plots were spoiled and had to be replanted on December 9. The manured plots again showed to advantage, with increases of over 100 lbs. seed cotton per acre.

NATAL AND ZULULAND.

Eshowe, Zululand.—In these experiments the results were less marked in favour of the manured plots. While superphosphate (100 lbs. per acre) showed an increase of 135 lbs., the two plots receiving the larger applications of basic slag, and all the residual plots, showed a decrease.

Tugela Valley, Weenen.—The manured plots showed slight increases (the yield was small on account of unseasonable drought) of 5 to 43 lbs., and the residual slag plots a slight decrease with the larger applications.

COTTON STATISTICS
CONSUMPTION AND STOCKS

BY

JOHN A. TODD, M.A., B.L.

THE chief feature of the end of season statistics of Consumption and Stocks for 1927-28 is that in the case of both American and Egyptian cotton, although the consumption was less than a year ago, it was still largely in excess of the crop, with the result that the carryover was heavily reduced.

As regards the world's consumption of American cotton, it is to be noted that the reduced consumption was entirely in the second half of the season. It was specially marked in the United States, where, as the result of a definite campaign for restriction, the consumption began to fall off in December and fell heavily from March onwards, the last two months of the season showing very big reductions. England, the Continent, and Asia also showed reductions in the second half-year, with the result that while the world's consumption for the first half of the season was at the rate of nearly 16¼ million bales, that of the second half was at the rate of less than 14½. As the real question for the immediate future is whether the coming season will continue the tendency of the latter half of last season, or will recover to something like the figures of the previous year, we have added the half-yearly figures to Table I. So far the only information available for the new season is, of course, the monthly U.S. consumption figures, and for the first three months these show a substantial recovery, though still, of course, below the corresponding figures of a year ago when every month was establishing new records. As the question of linters is causing increasing confusion in the consumption statistics, we have this year excluded them altogether from Table I., but the figures for the U.S.A., which were always the only available statistics, are given in Table II.

With regard to the relative position of the U.K., it is very unsatisfactory to note that the total consumption of American for the season is the lowest since 1923-24, when the world was suffering from what practically amounted to a famine of American cotton, and is actually lower than the totals of 1925-26 and 1926-27, when Lancashire's consumption was severely affected by the coal strike. Our consumption of Indian cotton was slightly increased this season, but that of Egyptian also showed a reduction; this, however, is probably explained by the increasing use of Sudan cotton, which presumably appears in Sundries. In spite of this, however, our consumption of Sundries was a little less than the previous season, especially during the second half. The result is that both in American and for All Kinds our total consumption for the season is still far below pre-war, while every other group in the table, even the Continent, now shows an increase. All this is shown in the accompanying diagram of consumption of American and of All Kinds in the various groups.

The statistics of the world's carryover of American and Egyptian cotton respectively are given in Tables III. and IV. They show a reduction of 2,590,000 bales in the case of American (including linters in U.S.A.), and 1,408,000 kantars in the case of Egyptian. In both cases the figure is now the smallest since July, 1925.

It is satisfactory to note that the acute controversy which raged round the whole question of consumption and carryovers last year has apparently fallen asleep this year. In effect this has been brought about by Colonel Hester reducing his consumption figures very substantially, so that his carryover figures are now practically identical with Garside's, and with our own, which are based largely on the Federation and the Census Bureau figures. The following table summarizes the figures of the various authorities since the Federation resumed publication of their figures after the War.

CONSUMPTION AND CARRYOVER OF AMERICAN COTTON.
(Running Bales 000's, excluding Linters.)

Season.	*Consumption.*			*Carryover.*			
	Federation.	*Hester.*	*Garside.*	*J.A.T.*	*Hester.*	*Garside.**	*Census Bureau.*
1919-20 ..	12,439	12,340	11,898	5,656	5,216	6,338	—
1920-21 ..	10,033	9,816	10,268	9,141	8,699	9,674	9,172
1921-22 ..	12,728	12,240	12,209	5,028	4,547	5,680	5,123
1922-23 ..	12,594	11,989	12,449	3,235	2,396	3,318	3,065
1923-24 ..	11,080	10,731	10,917	2,665	2,089	2,711	2,664
1924-25 ..	13,270	13,509	13,311	3,324	2,826	3,380	3,306
1925-26 ..	13,736	14,257	14,010	5,358	5,378*	5,501	5,631*
1926-27 ..	15,777	16,315	15,789	7,484	7,012*	7,794	7.838*
1927-28 ..	15,407	14,896	15,502	4,947	5,078*	5,121	5,079†
Averages	13,007	12,889	12,928	5,204	4,805	5,502	—

Including Eastern Stocks. † Provisional.

We have included the Census Bureau's carryover figures under reservation because their figure for the end of last season has only been received by cable without details, and is described as provisional. Their total is substantially the same as our own, but we do not know whether they include an estimate for stocks other than mill stocks in the Far East. We have never attempted to include these figures, as they are very unreliable; and this accounted for most of the difference between our figure and Garside's last year; but this year the figure involved is much smaller, and the difference is consequently of little importance.

(*Tables overleaf.*)

TABLE I.—WORLD'S CONSUMPTION OF ALL KINDS OF COTTON.

(FROM THE STATISTICS OF THE INTERNATIONAL FEDERATION.)

(*Running Bales, 000's Omitted—Excluding Linters*).

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*All Others.*	*Totals*
American ..	1911–13*	3,701	4,865	5,086	513	132	14,297
	1919–20	2,980	2,538	6,003	709	209	12,439
	1920–21	1,678	2,802	4,677	684	192	10,033
	1921–22	2,275	3,593	5,613	1,031	216	12,728
	1922–23	1,919	3,293	6,322	859	201	12,594
	1923–24	1,695	3,199	5,353	661	172	11,080
	1924–25	2,344	4,009	5,917	772	228	13,270
	1925–26	2,093	4,194	6,176	1,012	261	13,736
	1926–27	2,077	4,797	6,880	1,756	267	15,777
	1927–28	1,949	5,143	6,535	1,513	267	15,407
	1st Half	1,027	2,764	3,465	840	130	8,226
	2nd ,,	922	2,379	3,070	673	137	7,181
Indian ..	1911–13*	49	807	5	3,043	1	3,905
	1919–20	58	444	12	3,196	—	3,710
	1920–21	39	770	10	3,749	2	4,570
	1921–22	55	824	11	4,032	—	4,922
	1922–23	107	977	21	4,276	1	5,382
	1923–24	201	1,247	27	3,922	7	5,404
	1924–25	183	1,108	31	4,165	34	5,521
	1925–26	168	1,063	30	4,273	38	5,572
	1926–27	82	855	28	4,203	28	5,196
	1927–28	121	962	27	3,389	24	4,523
	1st Half	47	442	15	1,784	15	2,303
	2nd ,,	74	520	12	1,605	9	2,220
Egyptian ..	1911–13*	384	377	127	20	7	915
	1919–20	441	173	216	24	—	854
	1920–21	237	136	106	22	13	514
	1921–22	336	208	151	38	9	742
	1922–23	393	272	175	40	10	890
	1923–24	469	354	149	39	16	1,027
	1924–25	431	350	128	49	13	971
	1925–26	391	334	136	42	17	920
	1926–27	369	389	160	51	25	994
	1927–28	358	394	144	43	17	956
	1st Half	172	207	80	22	8	489
	2nd ,,	186	187	64	21	9	467
Sundries ..	1911–13*	140	1,946	26	774	939	3,825
	1919–20	141	116	160	1,077	614	2,108
	1920–21	70	1,039	67	981	672	2,829
	1921–22	199	716	114	980	708	2,717
	1922–23	351	616	98	1,262	850	3,177
	1923–24	353	529	76	1,351	576	2,885
	1924–25	277	896	66	1,523	785	3,547
	1925–26	370	1,619	58	1,308	1,103	4,458
	1926–27	482	1,511	64	1,362	753	4,172
	1927–28	476	1,557	64	1,646	911	4,654
	1st Half	275	591	30	593	480	1,969
	2nd ,,	201	966	34	1,053	431	2,685
All kinds ..	1911–13*	4,274	7,995	5,244	4,350	1,079	22,942
	1919–20	3,620	3,271	6,391	5,006	823	19,111
	1920–21	2,024	4,747	4,860	5,436	879	17,946
	1921–22	2,865	5,341	5,889	6,081	933	21,109
	1922–23	2,770	5,158	6,616	6,437	1,062	22,043
	1923–24	2,718	5,329	5,605	5,973	771	20,396
	1924–25	3,235	6,363	6,142	6,509	1,060	23,309
	1925–26	3,022	7,210	6,400	6,635	1,419	24,686
	1926–27	3,010	7,552	7,132	7,372	1,073	26,139
	1927–28	2,904	8,056	6,770	6,591	1,219	25,540
	1st Half	1,521	4,004	3,590	3,239	633	12,987
	2nd ,,	1,383	4,052	3,180	3,352	586	12,553

* Average of 1911–12 and 1912–13.

TABLE II.—U.S. CONSUMPTION OF COTTON BY VARIETIES.

(000's of Running Bales: Foreign in Equivalent 500-lb. Bales.)

		Total.	*Upland.*	*Egyptian.*	*Other Foreign.*	*Sea Island.*	*American Egyptian.*	*Linters. not Included*
Season's Totals.	1912-13	5,483·3	5,195·6	201·3	31·7	54·8	—	303·0
	1913–14	5,577·4	5,301·4	151·1	43·2	81·7	—	307·3
	1914–15	5,597·4	5,295·9	181·2	40·8	79·4	—	411·8
	1915–16	6,397·6	5,998·0	269·3	47·7	82·6	—	880·9
	1916–17	6,788·5	6,376·0	259·2	59·1	94·3	—	869·7
	1917–18	6,566·5	6,296·8	136·4	47·4	85·9	—	1,118·8
	1918–19	5,765·9	5,517·6	126·1	50·0	51·2	21·1	457·9
	1919–20	6,419·7	5,914·2	323·1	93·6	43·0	45 9	342·5
	1920–21	4,892·7	4,641·5	159·2	56·6	18·7	16·8	516·3
	1921–22	5,909·8	5,554·7	226·3	70·5	9·0	49·4	639·0
	1922–23	6,666·1	6,250·8	262·3	81·5	6·3	65·2	646·1
	1923–24	5,680·6	5,312·0	223·6	104·0	4·9	36·0	536·7
	1924–25	6,193·4	5,894·5	191·5	84·4	4·0	19·0	658·8
	1925–26	6,455·9	6,161·7	204·1	76·0	2·3	11·7	803·8
	1926–27	7,189·6	6,859·2	239·8	69·7	1·2	19·7	806·1
	1927–28*	6,832·7	6,519·9	216·8	80·7	—	15·3	757·4
Monthly Figures, 1926–27.	August ..	500·3	476·3	17·6	4·8	—	1·3	73·5
	September	570·6	539·8	22·9	6·1	—	1·8	74·8
	October ..	568·4	539·4	20·8	6·2	—	1 8	75·4
	November	583·7	559·9	16·4	5·5	—	1·9	63·2
	December	603·0	579·6	16·9	4·5	—	2·0	54·0
	January ..	603·2	578·5	17·3	5·6	—	1·5	55·0
	February	589·5	565·4	17·0	5·4	—	1·7	61·3
	March ..	693·1	663·6	21·8	5·9	—	1·8	69·2
	April ..	618·3	591·1	19·5	5·9	—	1·7	67·7
	May ..	629·9	600·4	22·1	5·6	—	1·8	72·0
	June ..	659·8	625·2	26·0	7·3	—	1·3	70·0
	July ..	569·8	540·6	21·4	6·7	—	1·1	69·9
*Monthly Figures, 1927–28.**	August ..	634·5	604·0	22·5	7·0	—	1·1	76·2
	September	627·8	599·7	19·8	7·1	—	1·1	80·4
	October ..	613·5	586·0	19·4	6·9	—	1·2	75·3
	November	625·7	597·7	20·5	6·2	—	1·3	62·0
	December	543·6	517·5	18·6	6·0	—	1·5	51·8
	January ..	582·4	554·5	20·1	6·4	—	1·6	54·5
	February	573·8	545·1	20·4	6·8	—	1·4	56·2
	March ..	581·3	555·9	17·0	6·9	—	1·5	61·4
	April ..	525·2	501·1	16·4	6·4	—	1·2	57·5
	May ..	577·7	543·8	14·9	7·8	—	1·2	62·0
	June ..	510·6	488.6	14·0	6·8	—	1·2	63·6
	July ..	438·7	417·4	13·5	6·6	—	1·3	62·9
1928*.	August ..	526·7	510·0	18·5	6·0	—	1·1	68·2
	September	492·2	469·5	16·1	5·9	—	0·7	68·6
	October ..	618·8	591·2	19·6	6·7	—	1·3	76·1

* Subject to revision.

TABLE III.—WORLD'S MONTHLY CARRYOVER OF *AMERICAN* COTTON.

(In Thousands of Running Bales, including Linters in U.S.A., also Sea Island and American Egyptian, but not Foreign Cotton.)

End of	*Stock and Afloat.*		*U.S.A.*		*Monthly Totals.*	*Federation.*	*Half-Yearly Totals.*	*U.S.A.*	*End of Season Totals.*
	U.K.	*Continent.*	*Mill Stocks.*	*Public Warehouses.*		*Other Mill Stocks.*		*Elsewhere.*	
1912, August ..	508	406	786	556	2,256	1,305	3,561	350	3,911
1913, August ..	423	282	699	492	1,896	1,011	2,907	375	3,282
1914, August ..	627	489	687	562	2,365	—	—	320	—
1915, July ..	1,238	753	1,491	1,839	5,321	—	—	850	—
1916, July ..	707	516	1,591	1,150	3,964	—	—	450	—
1917, July ..	237	332	1,521	1,069	3,159	—	—	440	—
1918, July ..	173	164	1,541	1,924	3,802	—	—	315	—
1919, July ..	806	486	1,519	2,402	5,213	—	—	1,150	—
1920, July ..	878	474	1,485	2,262	5,099	1,066	6,165	500	6,665
1921, July ..	839	805	1,222	3,874	6,740	1,137	7,877	1,960	9,837
1922, July ..	558	562	1,266	1,468	3,854	1,243	5,097	185	5,282
1923, July .	187	206	1,109	903	2,405	713	3,118	310	3,428
1924, July ..	228	310	739	695	1,972	688	2,660	220	2,880
1925, July ..	401	373	916	516	2,206	1,046	3,252	270	3,522
1926, July ..	579	406	1,155	1,946	4,086	959	5,045	595	5,640
August ..	512	354	958	1,722	3,546	—	—	—	—
September	554	620	964	3,301	5,439	—	—	—	—
October	727	824	1,255	5,497	8,303	—	—	—	—
November	990	1,153	1,558	6,551	10,252	—	—	—	—
December	1,195	1,444	1.852	6.582	11,073	—	—	—	—
1927, January	1,311	1,555	1,951	6,192	11,009	1,193	12,202	—	—
February	1,335	1,486	2,063	5,500	10,384	—	—	—	—
March ..	1,363	1,603	2,132	4,538	9,636	—	—	—	—
April ..	1,346	1,561	2,053	3,713	8,673	—	—	—	—
May ..	1,260	1,433	1,944	2,912	7,549	—	—	—	—
June ..	1,125	1,214	1,752	2,220	6,301	—	—	—	—
July ..	1,011	1,079	1,524	1,856	5,470	1,731	7,201	590	7,791
August ..	906	816	1,215	2,197	5,134	—	—	—	—
September	805	960	1,189	3,979	6,933	—	—	—	—
October..	782	1,174	1,401	5,455	8,812	—	—	—	—
November	764	1,408	1,652	6,000	9,824	—	—	—	—
December	728	1,411	1,835	5,685	9,659	—	—	—	—
1928, January	721	1,354	1,852	5,042	8,969	1,243	10,212	—	—
February	731	1,295	1,819	4,346	8,191	—	—	—	—
March ..	717	1,230	1,741	3,539	7,227	—	—	—	—
April ..	751	1,164	1,650	2.946	6,511	—	—	—	—
May ..	706	1,083	1,463	2,330	5,582	—	—	—	—
June ..	612	978	1,263	1,668	4,521	—	—	—	—
July ..	530	815	1,090	1.200	3,635	1,181	4,816	385	5,201
August ..	441	646	838	1,197	3,122	—	—	—	—
September	373	746	757	2,658	4,534	—	—	—	—
October	449	965	1,238	4,654	7,306	—	—	—	—
November	679	1,287	—	—	—	—	—	—	—

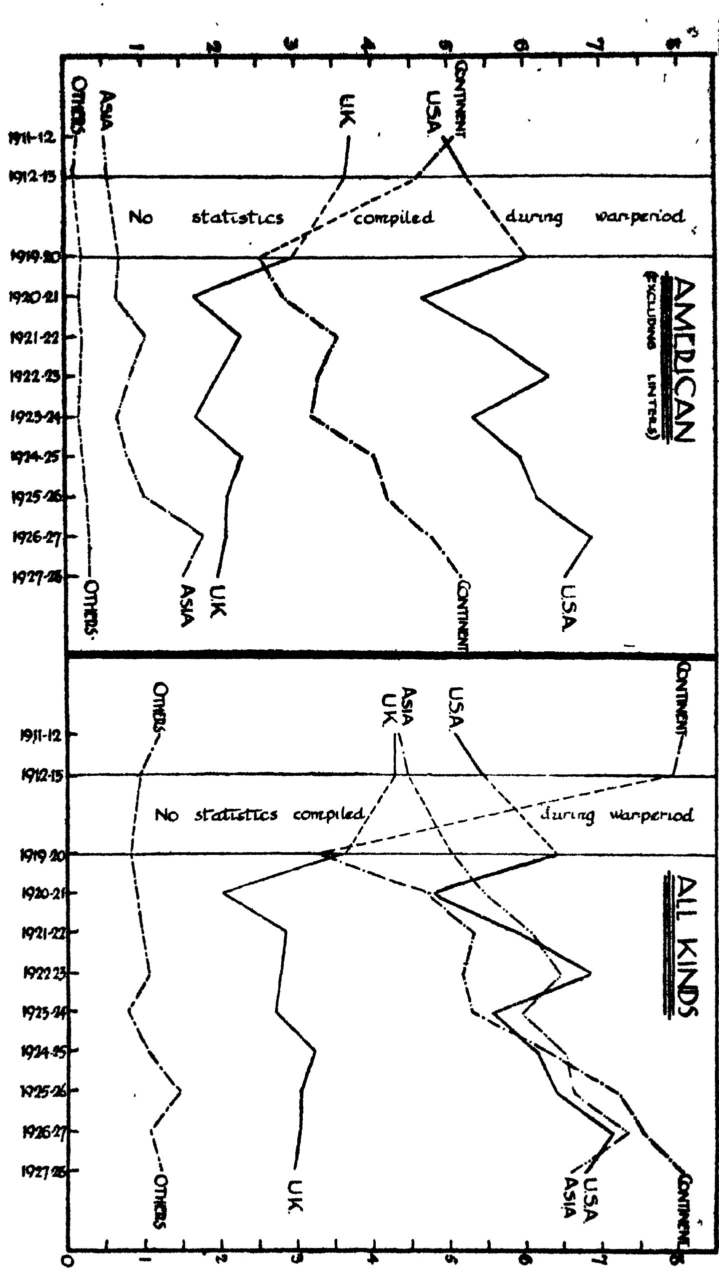
TABLE IV.—WORLD'S CARRYOVER OF *EGYPTIAN* COTTON.

(KANTARS 000'S BALES CONVERTED AT 7·5 KANTARS (EUROPE) AND 5·0 KANTARS (U.S.A.).)

End of	*Stock and Afloat.*		*U.S.A.*		*Alexandria.*	*Monthly Total.*	*Federation.*	*Half-Yearly Total.*
	U.K.	*Continent.*	*Mills.*	*Warehouses.*			*Half-Yearly.*	
1912, August ..	302	30	424*	—	350	1,106	1,387	2,493
1913, August ..	418	31	354	13	491	1,307	1,485	2,792
1914, August ..	467	10	259	26	766	1,528	—	—
1915, July ..	758	71	484	126	1,074	2,513	—	—
1916, July ..	351	50	617	296	104	1,418	—	—
1917, July ..	431	27	376	213	589	1,636	—	—
1918, July .	541	185	180	157	1,727	2,790	—	—
1919, July .	526	170	185	79	2,060	3,020	—	—
1920, July ..	466	79	587	514	601	2,247	1,365	3,612
1921, July ..	688	158	345	296	1,992	3,479	1,005	4,484
1922, July ..	835	148	314	267	1,669	3,233	1,252	4,485
1923, July ..	859	129	447	265	1,096	2,796	1,200	3,996
1924, July .	517	128	259	63	384	1,351	1,155	2,506
1925, July	443	75	253	57	411	1,239	1,103	2,342
1926, July ..	930	120	321	143	1,544	3,058	1,185	4,243
August ..	930	75	306	88	1,101	2,500	—	—
September	848	82	263	59	1,261	2,513	—	—
October ..	758	202	201	37	1,859	3,057	—	—
November	938	225	180	38	2,574	3,955	—	—
December	953	180	185	65	3,004	4,387	—	—
1927, January ..	885	158	247	82	3,303	4,675	1,058	5,733
February	1,102	158	243	72	3,215	4,790	—	—
March ..	1,275	180	277	67	3,286	5,085	—	—
April ..	1,320	203	263	87	2,982	4,855	—	—
May ..	1,395	143	282	67	3,086	4,973	—	—
June ..	1,372	143	257	73	2,716	4,561	—	—
July ..	1,260	143	295	66	2,392	4,156	1,283	5,439
August ..	1,088	127	277	67	1,816	3,375	—	—
September	908	112	262	88	2,240	3,610	—	—
October ..	780	165	230	85	2,842	4,102	—	—
November	735	210	256	73	3,208	4,482	—	—
December	758	187	274	94	3,228	4,541	—	—
1928, January ..	690	203	293	92	3,197	4,475	1,080	5,555
February	713	135	269	95	3,021	4,233	—	—
March ..	878	120	241	124	2,916	4,279	—	—
April ..	930	165	235	132	2,727	4,189	—	—
May ..	1,035	105	244	122	2,520	4,026	—	—
June ..	998	127	240	98	2,108	3,571	—	—
July ..	923	98	239	88	1,648	2,996	1,035	4,031
August ..	818	105	235	69	1,153	2,380	—	—
September	750	68	232	66	1,427	2,543	—	—
October ..	750	180	196	66	2,340	3,532	—	—
November	960	195	—	—	3,227	—	—	—

* Total foreign—details not given.

WORLD'S CONSUMPTION OF COTTON (from the INTERNATIONAL FEDERATION Statistics)



NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

1. **Indian Central Cotton Committee.** From the press communiqué of the seventeenth meeting held in July last, we quote the following from the opening speech of the President in connection with Indian cotton statistics: " It has been the Committee's constant endeavour to secure a greater degree of accuracy in the statistics relating to raw cotton. Several important advances have been made since the last meeting in this respect. The Government of India have acceded to our request and intend to re-introduce from October 1 complete returns for rail and river-borne raw cotton by trade blocks. These statistics should be of inestimable value to the officers responsible for the preparation of cotton forecasts. Further, cotton forecasts should be greatly improved by the issue of a fifth forecast in April by the Bombay, Baroda, Hyderabad, and Mysore Governments. This will include the latest information with regard to the Kumpta-Dharwar and Broach crops, which are not far enough advanced in February to permit of accurate forecasting. Further, the number of Indian States which have agreed to introduce a Cotton Ginning and Pressing Factories Act on the lines of the Act in British India is rapidly increasing, and with each fresh recruit more reliable statistics of India's total production are possible."

2. **Research in Cotton Technology in India, 1927.** By A. J. Turner. (*Bull.* No. 13, *Tech. Ser.* No. 8, 1928, Indian Central Cotton Committee.) This bulletin presents in a summarized form the results which have been published in 1927 of the work done in the Technological Laboratory. It is therefore based chiefly on the following bulletins:

" Technological Reports on Standard Indian Cottons, 1923-26," *Bull.* No. 7, *Tech. Ser.* No. 3, May, 1927.

" The Effect of Temperature and Humidity on Cotton Spinning, with Particular Reference to Conditions in Bombay," *Bull.* No. 9, *Tech. Ser.* No. 4, August, 1927.

" The Effect of Subjecting Cotton to Repeated Blow-room Treatment," *Bull.* No. 10, *Tech. Ser.* No. 5, September, 1927.

" Technological Reports on Standard Indian Cottons, 1927," *Bull.* No. 11, *Tech. Ser.* No. 6, November, 1927.

The present bulletin is for the most part concerned only with conclusions, the detailed evidence for which will be found in the originals. In some cases, however, short abstract tables, prepared specially for the present bulletin, have been inserted in order to give point to the conclusions.

The opportunity has been taken to present the subject-matter in as wide an aspect as possible, and for this reason it has been found necessary in many instances to amplify the discussion given in the original bulletins. The chief points in which there has been this extension of interest relate to the quality of cotton and the methods by which it can be determined; the importance of baling cotton only when it is in a clean condition, and the question whether this can best be done by clean picking in the first instance, or by the installation of pre-ginning cleaning machinery; the influence of spinning conditions on the human factor, and the consequent possibilities of their effect upon production; and the value of the procedure at the Technological Laboratory by which every spinning test is made in duplicate.

3. TECHNOLOGICAL REPORT ON RAJPIPLA COTTONS. By A. J. Turner. (Indian Cen. Cot. Committee, Tech. Laboratory, Bombay, August, 1928.) The tests forming the subject of the present report were carried out as a consequence of a rumour early during the season that the quality of Rajpipla cotton had deteriorated owing to the admixture of *Goghari* cotton, an inferior variety. Three bales of ordinary Rajpipla cotton and a sample of an inferior quality were tested against the standard cotton Surat 1027 A.L.F., supplied by the Government Farm, Surat. The samples were numbered as follows:

No. 399. Superfine Rajpipla.
No. 398. Fine Rajpipla.
No. 400. Fully Good Rajpipla.
No. 417. Rajpipla (inferior variety).

The results of the tests are stated to be as follows: "The Rajpipla cottons show certain differences in fibre properties from the standard 1027 A.L.F. On the average they are about 5 per cent. shorter, and have 14 per cent. less fibre-weight per inch. On the other hand, there is no practical difference between the spinning test results, except in the case of Sample No. 417, which gave rather weaker yarns. It may be that the difference in fibre-properties is due to the presence of *Goghari* cotton, which is known to be short and weak, and therefore possibly of less fibre-weight per inch; however, low fibre-weight per inch is commonly regarded as a desirable quality for a cotton. Moreover, these fibre differences may be due merely to difference in the locality or conditions of growth, to which the fibre-properties respond very readily. So far as samples Nos. 398-400 are concerned, seeing that the spinning test results remain unaffected, it is clear that if they contain any *Goghari* cotton, the quantity of it must be quite small; and in the case of Sample No. 417 the evidence points to the fact that the slight inferiority of this sample is not due to the mixing of inferior cotton such as *Goghari*, but to some difference in the locality or conditions of growth."

4. INDIA. *Ann. Rpt. of the Cotton Breeding Station, Kovilpatti, for* 1927-28. By V. Ramanathan. The following work on cotton is being carried out at the Station: (1) The isolation and purification of strains from the local cottons; (2) testing their relative merits in small plots, and (3) multiplying the seed of the most promising strains.

5. THE CROPS OF SIND: THEIR GEOGRAPHY AND STATISTICS. By G. R. Ambekar. (*Bull. No.* 150, 1927, *Dpt. of Agr., Bombay.*) *Cotton.*—A good general account of cotton growing in Sind is given on pages 71-80, with a map showing the distribution of the crop, and details regarding methods of cultivation. The principal pests and diseases injuring cotton are the following: Spotted bollworm, white ants, red cotton bug, locusts, cotton wilt, and anthracnose.

6. LOSSES AND GAINS OF NITROGEN IN AN INDIAN SOIL STUDIED IN RELATION TO THE SEASONAL COMPOSITION OF WELL WATERS, AND THE BEARINGS OF THE RESULTS ON THE ALLEGED DETERIORATION OF SOIL FERTILITY. By H. E. Annett *et al.* (*Mems. of the Dept. of Agr. in India, Chemical Series*, ix., 6, 1928. Obtainable from Govt. of Ind. Central Pubns. Branch, Calcutta. Price Rs. 2, or 3s. 6d.)

COTTON IN THE EMPIRE (EXCLUDING INDIA).

7. The following reports have recently been received:

CEYLON: Administration Rpt. of the Dir. of Agr. for 1927.
Reports of Divisional Agricultural Officers for the year 1927.
Technical Reports for the year 1927.

Cyprus: Ann. Rpt. of the Director of Agriculture for the year 1927.
Colonial Ann. Rpt. for 1927.
Egypt: Rpt. on the Econ. and Finan. Situation of Egypt. E. Homan Mulock, 1928.
Gold Coast: The Gold Coast Handbook, 1928.
Kenya Colony: Ann. Rpt. of the Dept. of Agr., 1927.
Nigeria: Ann. Rpt. on the Agr. Dept. for the year 1927.
South Africa: Official Year Book of the Union of South Africa, 1926-1927.
Sudan: The Director's Ann. Rpt. for 1927-1928, Central Economic Board, Sudan Government.
Swaziland: Colonial Ann. Rpt. for 1927.
Uganda: Ann. Rpt. of the Dept. of Agr. for the year ended December 31, 1927.
Colonial Ann. Rpt. for 1927.
Meteorological Observations, 1927.
West Indies: Rpt. on the Agr. Dept., St. Lucia, 1927.
Rpt. on the Agr. Dept., St. Vincent, 1927.

8. ASIA: Ceylon. *Cotton Cultivation*, 1926-27. (Abstr. from the *Admin. Rpt. of the Dir. of Agr. for* 1927, pt. iv., *Education, Science, and Art*, D. 14, recently received.) The season was not a good one for cotton, as crop yields were reduced by the unseasonal rains during the early months of the year. Growth was exceedingly promising, but heavy boll and flower shedding occurred. There was a slump in prices, and Government undertook, in order to maintain prices, to pay a subsidy of Rs. 5.50 per cwt. of seed cotton.

The erection of buying stores at Bata-ata and Middeniya was of great assistance in the purchase of cotton, and was much appreciated by the growers, who were thus enabled to secure cash for their crops at convenient centres, and the direct purchase at other centres on definite dates was rendered less arduous to the divisional staff.

Interest in cotton in the Hambantota district continues, and 1,588 acres have been granted for cotton cultivation during the 1927-28 season.

9. *Cotton Cultivation in the Hambantota District*, 1926-27. (Abstr. from the *Rpts. of Div. Agr. Officers for the Year* 1927, recently received.) Unseasonal and unusually heavy rains during March ruined the excellent prospects of a record crop. Seven tons of locally grown Cambodia cotton seed were distributed, and the germination was good. The quality of the cotton produced was fairly good, and it was carefully graded. No serious damage from pests and diseases was recorded.

Considerable keenness was shown in the cotton competition, which resulted in greater attention to improved methods of cultivation, especially as regards weeding and earthing up. Special mention deserves to be made of the first prize winner for Magam pattu, W. G. G. Carolis, of Beragama, a very sound and efficient cultivator, who secured a bumper crop of 28 cwt. of seed cotton from an area of four acres, thereby causing a local sensation.

10. *Cotton Selection Work at the Ambalantota Station*, 1927. (Abstr. from the *Admin. Rpt. of the Dir. of Agr. for* 1927, pt. iv., *Education, Science, and Art*, D. 15.) Special mass selection was carried out at the station, and some special individual selection work was done in the Cambodia and Durango varieties. The Durango type is attacked by jassid in the Hambantota district, but one hairy plant of this variety was isolated and selected for future breeding work. The seed unfortunately failed to germinate, and the search for a hairy variety of Durango will have to be continued.

11. *The Economic Development of the Dry Zone of the Island.* By F. A. Stockdale. (Abstr. from *Trop. Agriculturist*, lxx., No. 6, 1928, p. 439.)

In referring to cotton, Mr. Stockdale points out the danger to this crop arising from unseasonable rainfall. He states that yields of cotton have not been as heavy on the average as was anticipated, due partly to the crop being grown on new lands, and to the consequent increased vegetative growth. In certain areas better crops have been secured in the second year. The real problem for Ceylon is to cheapen the costs of cultivation, which can only be done by the greater use of implements for ploughing, weeding, intercultivation, etc.

12. *Rotation of Crops on Lands in the Dry Zone.* (Abstr. from the *Admin. Rpt. of the Dir. of Agr. for* 1927, pt. iv., *Education, Science, and Art*, D. 12, recently received.) Results from the rotation stations established at Middeniya and Bata-ata in the Hambantota district, and at Vavuniya in the Mullaittivu district, showed that the cotton crops were generally satisfactory considering the unfavourable weather at the early part of the year, but the crop at Vavuniya suffered severely from leaf roller. Grain crops were also satisfactory, but pulse crops, except black gram, were seriously damaged by the wet season. In experiments at the Ambalantota Station chillies and tomatoes proved good money crops, whilst at Embilipitiya groundnuts are promising. Kurakkan crops after cotton have also given good results, as well as crops of tenai. Work on the stations at Dambulla and Maho commenced during the year. At Dambulla satisfactory crops of cotton, maize, sorghum, and kurakkan were growing at the end of the year, whilst at Maho crops were rather late, owing to a late sowing, but the cotton, green gram, and groundnut crops were promising.

13. AFRICA: KENYA COLONY. *Cotton Cultivation.* (Abstr. from the *Ann. Rpt. of the Dpt. of Agr.*, 1927, recently received.) An intensive campaign of encouragement in Kavirondo resulted in the planting of 20,000 areas of cotton in 1927, about four times the area planted in the previous season. Owing to the failure of the short rains, and to damage by hail in the Malakisi area, the yield per acre was not expected to equal that of the previous season, but in view of the increased acreage it was anticipated that a quantity substantially in excess of that of last year would be harvested.

For the 1926-27 crop the average price for " A " quality was approximately 12 cents per lb. seed cotton, but a substantial increase over this price was anticipated for the 1927 planted crop. The buying season opened at 20 cents per lb. for seed cotton.

The following pests were observed during the year under review: Spiny Bollworm (*Earias insulana*), False Codling Moth (*Argyroploce leucotreta*), Red Cotton Stainer (*Dysdercus* sp.), Cotton Seed Bugs (*Oxycarenus hyalinipennis* and *O. gossypinus*), Aphis. The damage caused by Pink Bollworm was considerably less, since this pest is now to a great extent controlled by a Braconid parasite, as mentioned in the previous year's report. This parasite has been named *Microbracon kirkpatricki* in honour of its discoverer. Consignments of the parasite have been sent to Egypt, and other countries are interested in its introduction to their territory.

14. NIGERIA. *The Cotton Industry.* (Abstr. from the *Half-yearly Rpt. to March* 31, 1928, recently received from the Actg. Director of Agriculture.) *Northern Provinces: American Cotton, Season* 1927-28.—The grading has again been carried out satisfactorily, and the percentage of Grade II. cotton has not been greater than usual.

It has been possible this season to place one Agricultural Officer in charge of the markets in each Emirate, and this has been a very satisfactory arrangement which has resulted in closer supervision than hitherto.

The total export of cotton for the season has fallen short of last year's figure by some 1,000 bales. The decline is attributed to the meagre rains in 1926, which caused the yields of all the staple crops to be well below the average. This resulted, in 1927, in food crops being given priority over cotton in the cropping scheme, and consequently in a relatively small area of cotton. The low prices ruling in the 1926-27 season, which made cotton-growing relatively unremunerative, also contributed to the restriction of the 1927-28 output.

Southern Provinces.—The total output of the Southern Provinces for the 1927-28 season is not expected to exceed 4,000 bales. This is due to the very adverse climatic conditions experienced during the season, and to the influence of the low prices ruling in 1926-27 which resulted in a restricted acreage being planted.

Prospects for the 1928-29 *Season.*—The demand for seed in the Northern Provinces has been normal, and given a favourable season, a very satisfactory crop is anticipated.

15. *Empire Cotton Growing Corporation and Cotton Seed Supply* (Abstr. from the *Ann. Rpt. on the Agr. Dept. Nigeria for the Year* 1927, p. 3.) From this report, a copy of which has recently been received from the Department of Agriculture, we quote the following:

"The farm of the Empire Cotton Growing Corporation at Daudawa has now reached a stage when it should be able to play an important part in the machinery of multiplication of selected seed. Simultaneously the first pure selfed selections made by the Botanist at Samaru have reached the stage where they could be compared with the produce of the 'mass-selected' seed produced at Maigana by less scientific methods. One of these selections seems likely to prove at least equally as good as the best of the 'old' strains, and since the plants are much more uniform in type, it seems reasonable to hope that this new strain will not deteriorate in uniformity in the course of multiplication so much as the old ones have appeared to do, and thus when multiplied the new strain should constitute a definite, albeit probably a small, advance.

"The time was very opportune indeed for the visit to this country which was made by Mr. Engledow, of the Cambridge School of Plant Breeding, and Colonel French, on behalf of the Corporation. Their visit resulted in the general reconsideration and clearing up of all outstanding questions affecting the Corporation's activities here, and the formulation of detailed plans for work and co-operation on both sides during the next year or two, which I believe will prove very satisfactory. Incidentally, I should like to take this opportunity to record the personal pleasure, and the valuable benefits by way of fresh inspiration, which I believe every officer concerned derived through talking over his work and problems with Mr. Engledow, and to express our gratitude to the Corporation for sending him out to us."

16. *Ishan Cottons.* (Abstr. from *Ann. Rpt. on the Agr. Dpt. for the Year* 1927, recently received.) Three thousand lb. weight of this seed was available for 1927-28, and sufficed to sow 1,330 acres in Oyo and Meko. To keep the strains as pure as possible, a search was made for all old cotton plants in the vicinity, and for all "rogues" in the "Ishan" farms; these were destroyed. The only further requisite was a good cotton-growing season, but this unfortunately turned out to be the worst growing season since 1922-23. Despite this, however, over 25 tons of improved seed were available for farmers in 1928. More than 500 farmers from all the cotton-growing areas visited the Ishan cotton areas early in 1928, and it is thought that the merits of the new cotton are now sufficiently widely known to induce a farmer to pay the trifling sum of 3d. to get enough good cotton seed for his farm. The export of last year's crop of Ishan lint amounted to seventy bales; the seed available in 1928 is sufficient to yield 2,500 bales. Meko has been found to be a very suitable place for the multiplication of cotton; it is compact and isolated, the farmers are keen cotton growers, and the land is good. It is proposed that the Senior Botanist should grow enough improved cotton each year to supply Meko, which will serve as a reservoir of pure seed to feed the cotton farms of the Abeokuta and Oyo Provinces. The price of Grade I. "Ishan" cotton at line stations has varied from 2¼d. to 2¾d. as compared with 1⅝d. to 1⅞d. for Grade I. native cotton.

Aided by a season in which the cotton was particularly clean, 86 per cent. of the improved Ishan cotton purchased has so far been Grade I. On the other hand, only 0·27 per cent. of the ordinary native cotton bought in the markets has come up to this grade, although even this is an improvement on the proportion of 0·005 per cent. for the previous year. The proportion of stained and damaged cotton in the first grade Ishan has averaged far less than the 11 per cent. permissible.

17. SOUTH AFRICA. *The Cotton Industry.* (Abstr. from the *Official Year Book of the Union of South Africa*, 1926-27, p. 459.) From the section headed "Cotton," contributed by Mr. Pieter Koch of the Dept. of Agriculture, we quote the following: "At present South Africa produces only a small amount of the world's supply. The farmers in this country have for many years (since about 1860) been trying to produce cotton, but until a few years ago (about 1912) their efforts met with failure owing to lack of knowledge of cultural methods, and want of gins and means of conveyance. Cotton culture has, however made rapid progress in recent years, especially in the middle and low veld of the Transvaal and Natal, where conditions are ideal for the crop, and the future is now most promising. The great possibilities of cotton in those parts are causing widespread interest, and a realization of the very important part it will play in the development of the vast, sparsely populated, and fertile regions in the hotter parts of the Union. The periodical droughts to which large areas of the country are subject have further concentrated attention on this plant. When maize and other crops failed, cotton grew, stood the trying conditions, and yielded a profitable return."

18. SWAZILAND. *Cotton Cultivation in* 1927. (Extracted from *Col. Ann. Rpt.*, 1927, No. 1404, p. 7.) "Cotton production showed a decrease owing to a smaller acreage being planted, and to the depredations of the jassid, bollworm, and other pests. The yield will continue to be low until an ample supply of jassid-resistant seed is available, in connection with which a good deal of work has been carried out by Mr. R. C. Wood, the Cotton Specialist of the Empire Cotton Growing Corporation, and his successor, Mr. D. MacDonald."

19. SUDAN. *Effect of the Gezira Irrigation Scheme.* (Abstr. from *The Director's Ann. Rpt.*, 1927-1928, p. 7, *Coml. Intell. Branch, Cent. Econ. Board, Sudan.*) "The opening up of the communications of the country, the growth of an active trading class, and the greater confidence displayed by the people in times of adversity, are the product of a gradual development. The most powerful new factor in the situation, which it has influenced profoundly, is the great cotton-growing scheme on the Blue Nile in the Gezira. Its effects have been far-reaching in many directions, and it has proved the mainstay of the country during the last two years of depression. It was most fortunate that gravitation water from the Sennar Dam became available for the first time just at this critical juncture, enabling 80,000 acres to be put under cotton, and large areas to be cultivated with grain and forage crops, and that in the second year of shortage this area of cotton was increased to 100,000 acres, and that of dura to 50,000 acres.

In both years the yield of cotton was extremely good, so that trade was greatly assisted by the money received by the tenants on the scheme for their cotton, their share amounting to some £E. 2,000,000, but from the general point of view, that is, in helping to preserve the economic life of the northern areas of the country in a period of want and misfortune, the main value of the scheme, apart from the actual grain grown on it, was the opportunity it afforded to thousands of people to earn the wherewithal to obtain food by subsidiary services, such as hoeing and picking. There has been a great drift of seasonal casual labour into the scheme from many parts of the country, and especially from White Nile Province, where owing to poor rains, local food supplies were very scanty."

20. *Agricultural Research Work in the Sudan.* (Issued, with the consent of the Sudan Government, by the Empire Cotton Growing Corporation, 1928. Obtainable from the Controller, Sudan Government Offices, Wellington House, Buckingham Gate, London, S.W. Price 2s. 6d., postage 4d.) In this volume are included the following reports from the various sections engaged in agricultural research in the Sudan for the season 1926-27, and programmes of work for 1927-28:

Agricultural Report on the Gezira Irrigation Scheme, 1926-27.
Ninth Annual Report of the Gezira Research Farm, 1926-27, and Programme of Experiments, 1927-28.
Report of the Botanical Section of the Gezira Research Farm, 1926-27, and Programme of Work for 1927-28.
Gezira Irrigation Scheme; Seed Farm Report, 1926-27, and Programme of Work for 1927-28.
Report by the Director, Wellcome Tropical Research Laboratories, on Chemical and Entomological Research carried out in connection with cotton growing in the Gezira during the season 1926-27.
Work of the Chemical Section, 1926-27.
Work of the Entomological Section, 1926-27.
Chemical and Entomological Research Programme for the Gezira, season 1927-28.
Work of the Section of Plant Physiology and Pathology, 1926-27, and Programme of Work for 1927-28.
Work of the Plant Breeding Section.

A great amount of detailed work is described in the various reports, and the volume is well furnished with diagrams.

21. *Gezira Research Farm.* (Abstr. from *The Director's Ann. Rpt.*, 1927-28, p. 26, *Coml. Intell. Branch, Centr. Econ. Board, Sudan.*) The Director of Agriculture and Forests states that experiments have been carried out with a variety of American cotton to combine strength of staple with early maturity for rain land, and in tracing the incidence of Blackarm in relation to soil temperature, which has a direct practical bearing on the time of sowing and seed supply. Investigations have also been made in connection with manures and water economy, which are of direct practical importance.

22. *Eastern Gezira Soil: Permeability.* By Dr. H. Greene. (*J. Agr. Sci.*, 1928, **18**, 531-543. Abstr. from *Summ. of Curr. Lit.*, viii., **19**, 1928, E. 56.) An account is given of studies of moisture content in the field. The results are in agreement with Joseph's view, that the relation between salt content and fertility is chiefly due to the effect of sodium salts on soil texture. Studies of changes of moisture content in land under native cultivation and under irrigation are described. The water requirement of cotton in this region is extremely high, the danger of water strain is correspondingly acute. The effect of fourteen days' flooding is taken as a measure of permeability. The genesis of Gezira soil is briefly discussed with regard to the use of gypsum as a corrective. Marked improvements in permeability have been brought about by applications of this substance.

23. *Cotton Prospects.* (Abstr. from the *Monthly Rpt. of the Coml. Intell. Branch, Cent. Econ. Board*, October, 1928.) This report gives a generally favourable account of the cotton crops.

24. TANGANYIKA. *Agricultural and Industrial Exhibition*, 1928. We have received from the Tanganyika Estate Offices (the Secretaries, P.O. Box 220, Dar-es-Salaam) a pamphlet describing the aims of this Exhibition, which is to be held in Dar-es-Salaam in September, 1928. There are altogether twenty-two sections, of which special mention may be made of E (Farm Produce, including wool) and F (Tropical and Plantation Produce: sisal, cotton, tobacco, tea, sugar, and sugar-cane). Other sections include Native Industries, Forestry, Local Manufactures, etc.

25. UGANDA. From the *Ann. Rpt. of the Dept. of Agr.*, 1927, recently received, we learn that the rainfall throughout the Protectorate was generally below the average, and the unfavourable climatic conditions adversely affected all crops. During the year, 533,004 acres were planted to cotton. With the completion of the Kenya and Uganda railway to Jinja, the greater part of the crop from the Eastern Province is now railed direct to Mombasa, thus avoiding the necessity of crossing Lake Victoria, with consequent reduction in the number of transhipments. During the year 188 ginneries were licensed to gin and bale cotton. The cotton grader visited 106 working ginneries, and reported that the quality of the cotton was good. The total number of ploughs in use in the Teso district was 2,941, as compared with 2,710 in the previous year; in the Bugwere district approximately 1,275 ploughs were in use.

The Cotton Botanist describes the experimental work carried out at the Serere Experimental Station (p. 28), fuller details of which are to be found in the Empire Cotton Growing Corporation's *Reports from Experimental Stations*, 1927, p. 177. The work of the Assistant Entomologist (p. 34) relates to investigations on cotton stainers, and the report of the Government Mycologist (p. 39) deals with the injury due to various cotton diseases.

26. *Crop Prospects*, 1928-29. The latest report from the Department of Agriculture states that the condition of the crop is satisfactory in all districts except Masaka, where, owing to the continuation of the dry weather in southern Buddu, and to damage by hail in the north-eastern areas, the crop condition is below average.

27. WEST INDIES: COTTON CULTIVATION IN BARBADOS, 1926-27. By J. L. Wilson Goode. (Abstr. from a *Rpt. on the Trade Situation in Barbados*, dated August, 1928, p. 3, copy of which has been received from the Dept. of Overseas Trade.) "According to the Acting Director of Agriculture, the cotton crop of 1926-27 suffered even worse from the ravages of pink bollworm than in the previous year. In certain districts there was a considerable outbreak of the diseases arising from infection with *Bacterium malvacearum*, causing the condition known as 'black arm'—leading to the drying up of fruiting branches—and the condition known as 'bacterial boll disease,' arresting the normal development and causing the shedding of bolls. In consequence of these diseases the yield of cotton was the lowest for many years."

28. COTTON IN MONTSERRAT. (Abstr. from *Trop. Agriculture*, v., 11, 1928, p. 289.) In a letter written after the hurricane of September 12 and 13, the Curator states: "The new experimental ginnery recently erected at Grove, which contained all our self-bolls and pedigree seed cotton from the breeding plots, was wrecked. I have, however, been able to dry out all seed cotton, and have no fear of losing our strains."

Prior to this communication he had written: "A very early and satisfactory cotton crop is being reaped." It is fortunate for the island that most of this crop was shipped before the disaster occurred.

29. COTTON CULTIVATION IN ST. LUCIA. (Abstr. from the *Rpt. on the Agr. Dept.*, 1927, p. 8, recently received.) A plot of Sea Island cotton was sown to provide seed for distribution to planters who have continued to grow this crop on a small scale. The plot was arranged to provide information on seed and lint weight of plants when grown singly or with two plants per hole, the holes being spaced 4 by 2 feet in two series of ten rows each. The results showed that from the one plant per hole plot the weight of lint with seed was 47 lb., and from the two plants per hole plot, 80 lb.

30. ST. VINCENT. *The Cotton Industry.* (Abstr. from the *Rpt. on the Agr. Dpt.*, 1927, recently received.) During the season 1926-27, there were 3,055 peasant growers with an acreage of 3,088 acres under Sea Island cotton; during the season under review there were 1,733 peasants with 1,594 acres. This decrease was undoubtedly due to the ravages of the cotton worm, which occurred in 1926-27 and caused loss to growers, and consequently many grew crops of a less risky nature.

The 1927-28 crop is expected to give a very poor yield, owing to the indifferent cultivation given to the cotton fields by the growers, and to the damage caused by soft rot and the attacks of pink bollworm.

31. *Cotton Report.* A note received from the Agricultural Superintendent on the cotton crop for the quarter ended September 30, 1928, is to the effect that there will be an increase in the area planted under Sea Island cotton this season. Cotton caterpillars appeared towards the end of the quarter, and at the time of writing were present on practically all estates growing cotton situated in the Windward District; they were, however, not causing serious damage. Bronze Beetles (*Colaspis fastidiosa*) were common in fields during the early part of the quarter. Normal weather had been experienced.

32. AUSTRALASIA: QUEENSLAND. *The Cotton Industry.* (Abstr. from *Dalgety's Ann. Wool Rev. for Australasia*, 1927-1928, p. 149.) It is expected that the yield this year will be considerably in excess of that of last year.

Last season was the first year in which the ginning, marketing, and handling of the crop was carried out under grower-control through the Cotton Board. The results have more than justified this means of handling the business. The arrangements for the control and handling of the crop have resulted in a saving of from £12,000 to £15,000 on any other arrangement which could have been entered into. The whole of last season's crop was sold within the Commonwealth, and although during the season the prices were exceptionally low, growers received a payment equivalent to that during the previous five years, when the cotton market was at its best.

33. FIJI. *The Possibilities of a New Variety of Cotton for Fiji.* By R. R. Anson, Cotton Specialist. (*Fiji Agr. Jour.*, 1928.) In forwarding a copy of this article, Mr. Anson states that " the general outlook is somewhat brighter as far as cotton is concerned. Indians and Fijians are again interested, and it is anticipated that we shall have 700 acres under the new variety in this district next season, and if the prices fixed by the Government are regarded as satisfactory, 2,000 acres of Sea Island in all the other districts."

In the article Mr. Anson points out that the uncertainty of the market renders it desirable to replace Sea Island by a more saleable variety, and describes the work that has been done to produce this. The most promising variety at present is a Kidney Hybrid, which originated from some selections made by Mr. Evans in New Guinea, the seeds of which do not adhere together as in ordinary Kidney cotton.

The type that it is hoped to produce is a robust one with single stem and open habit of growth, and a large full-opening boll possessing strong lint of uniform length and good drag. The Sea Island crop planted in mid-November matures in April, and picking lasts until the end of July; the Kidney crop planted at the same time matures in June, and picking continues until the end of September. This just fits in with the driest months, and it is, therefore, hoped that it will be possible to obtain a higher percentage of first-grade cotton than is the case with Sea Island.

(We shall be interested to hear of any further experiments that may be carried out.—Ed.)

84. *An Interim Report on Cotton.* (*Council Paper No.* 34, 1928. From the Supt. of Agr. to the Colonial Secretary, May 31, 1928.) Returns to growers of Sea Island cotton have been unsatisfactory in recent years, and attempts are being made at the Cotton Experiment Station to produce a good type of Kidney cotton from selections made by Mr. Evans in New Guinea, which may prove more remunerative to cotton growers. Two of these selections appear promising, and in the event of this cotton appealing to Indians and Fijians, and possibly to European planters, there is a possibility that from 5,000 to 10,000 bales might be produced annually in a few years' time.

In spite of the very unfavourable season, Mr. Anson, the Cotton Specialist, hopes to have sufficient seed of the new variety to enable 600 acres to be planted in November, 1928, and the yield and experience gained from this acreage should be sufficient to test the market and to arrive at costs of production and ginning.

COTTON IN EGYPT.

85. We have received from the Department of Overseas Trade a copy of the *Report on the Economic and Financial Situation of Egypt*, dated May, 1928, by E. Homan Mulock. Information is given regarding transactions in cotton, sales of cotton to Russia, and loans on cotton. Appendices are included showing the exports of raw cotton in 1926 and 1927, the countries of destination, and the value in £E.

86. Cotton Improvement in Egypt. By A. M. Psalti. (Abstr. from *Egyptian Gazette*, July 17, 19, and 21, 1928.) In a series of three articles in the *Egyptian Gazette*, Mr. Psalti begins by pointing out the great disadvantages resulting from the practice of mixing different varieties of cotton in Egypt. He attributes the custom primarily to the high premia commanded by the best varieties, such as Sakel, after the war, when huge profits could be made by mixing cheaper cottons with this variety and selling it all as Sakel. The Government was obliged to intervene, and two laws were introduced, the one giving the Government power to assume full control of the purity and germination capacity of cotton seed, and the other prohibiting the artificial mixing of different varieties of cotton. These laws have already produced valuable results, but the author is of opinion that they do not go far enough, especially in the punishment of offences.

Mr. Psalti then deals with the difficulties that confront the worker in seed selection, especially the natural tendency to crossing of varieties, and points out the main features at which to aim in selecting cotton seed, such as long, strong, and fine staple, earliness in ripening (to escape injury by pink bollworm), good yield per acre, small size of seed, and high germination percentage, special attention being devoted to this latter question.

COTTON IN THE UNITED STATES.

87. American Cotton. Annual Review. (*Man. Guar. Coml.*, August 30, 1928.) The usual valuable review, containing among others the following interesting articles. "Review of the 1927-28 Season; Markets behave Logically

in the Long Run," by W. G. Reed; "Prospects for the New Season: Southern Growers' Efforts for another Big Crop," by C. T. Revere; "Supply, Price, and Consumption," by H. L. Bean; "Accurate Crop Forecasts," by W. F. Callander; "Financing the Cotton Farmer," by F. J. Cavanagh; "Co-operative Marketing," by C. O. Moser; "Congress and the Cotton Markets," by F. W. Jones; "Crop and Price Relationships," by J. A. Todd; "Grade and Staple of the New Crop," by G. W. Fooshe; "Manufacturers and Hedging," by G. W. Fooshe; "Consumption and Carryover," by J. A. Todd.

38. MARKETING AMERICAN COTTON IN ENGLAND. By A. B. Cox. (*U.S. Dept. of Agr. Tech. Bull. No.* 69, 1928, *Washington, D.C.*) A detailed and readable account of the marketing of American cotton in England given under the following heads: Europe as a Cotton Market; Relative Importance of England and the European Continent as Consumers of American Cotton; Location of the Cotton Industry in England; Scope of the Analysis; The Manchester Yarn and Cloth Market; Manchester Raw Cotton Market; The Liverpool Cotton Market; The Liverpool Spot Market; Marketing Cotton to Spinners in Liverpool; Liverpool Merchants' Methods of buying American Cotton; Liverpool Cotton Futures Market; Some Comparisons between American and Liverpool Futures; Other Cotton sold in England.

39. MARKETING AMERICAN COTTON ON THE CONTINENT OF EUROPE. By A. B. Cox. (*U.S. Dept. of Agr. Tech. Bull.* No. 78, 1928, *Washington, D.C.*) A similar production to the foregoing, dealing with the subject under the following main heads: General Aspects of Cotton Marketing on the Continent; Marketing American Cotton in Northern Europe; Marketing American Cotton in Southern Europe; Cotton Marketing in Spain.

40. FUTURES VALUES IN THE COTTON MARKET. By F. J. C. (*Commerce Monthly*, pubd. by the National Bank of Commerce in New York. Reprinted in *Text. Recorder*, xlvi., **546**, 1928, p. 47.)

41. FIELD CROPS WORK IN GEORGIA, 1927. (*Georgia Sta. Rpt.*, 1927. Abstr. from *Exp. Sta. Rec.*, 59, **3**, 1928, p. 221.) Cotton plants grown in a solution including ammonia and nitrate nitrogen absorbed nitrogen at the rate of thirty-five parts ammonia nitrogen to 100 nitrate nitrogen for the first two weeks. This ratio gradually changed to about 55:100 when the plants were six weeks old. Cotton did better in solutions with only nitrate nitrogen than in one containing only urea nitrogen, and did not grow in a solution containing ammonium acetate or potassium nitrite.

Seed cotton yields rose from 669 lb. per acre with no nitrate to 814 lb., with 233 lb. of sodium nitrate, and top-dressing with sodium nitrate returned the best yields when applied at chopping, and of ammonium sulphate half at planting and half at chopping. A comparison of mixtures of sodium nitrate with cotton-seed meal for cotton showed it profitable to mix a small quantity of meal with the nitrate. Cotton yields from nitrogen derived from a number of sources are tabulated. Two hundred lb. of Nitrophoska (32-16-16) gave better results than when made up with dry sand to 800 lb. of 8-4-4. Sulphur seemed to preserve the quantity of nitrogen in the organic matter of compost, and to delay manure from becoming waterlogged or soggy. Cotton spaced 12 and 13 inches apart outyielded that at wider and closer distances, and weed removal without cultivation surpassed ordinary cultivation. The 1927 survey of the length of staple in Georgia cotton showed 2·4 per cent. of the State crop to be $\frac{13}{16}$ inch and less, 77·9 per cent. $\frac{7}{8}$ inch, 15·6 per cent. $\frac{15}{16}$ inch, and 4·1 per cent. 1 inch and

42. IRRIGATION OF COTTON. By J. C. Marr and R. G. Hemphill. (*Tech. Bull.* No. 72, 1928, *U.S. Dept. of Agr., Washington, D.C.*) According to United States census reports, there were in 1909 only 8,607 acres of cotton under irrigation, but it is estimated that in 1926 cotton was grown under irrigation on more than 650,000 acres in the four States of California, Arizona, New Mexico, and Texas. The possible area is limited by the supply of water available. The proper management of the supply of water to the plant is a matter of great importance, the amount required varying considerably at different seasons. Details are given under the headings: Soils, Preparing Land for Irrigation; Preparation for Planting; Irrigation before or at Planting; Planting; Varieties; Thinning; Cultivation; Irrigation; Indications of Need of Irrigation; Quantity of Water used in Irrigation; Water requirements in the Irrigation of Cotton. The bulletin is very thorough, and is well illustrated.

43. WIDE RANGE IN COTTON-GROWING COSTS. By W. Whittam. (Abstr. from *Text. Rec.*, xlvi., 545, 1928, p. 75.) "Costs of growing cotton ranging from 8 cents per lb. of lint to 59 cents per lb. during the 1927 season have been reported to the U.S. Department of Agriculture by 992 cotton growers. Most of the growers reporting on their costs had yields higher than the average of 154 lb. per acre reported by the Federal Crop Reporting Board.

"The Department has tabulated the costs by yield groups. Forty-five farmers reported yields of 60 lb. and under per acre at an average cost of 59 cents per lb. of cotton. On the other hand, twenty-three farmers reported yields of more than 500 lb. per acre at an average cost of 8 cents per pound. Seventy-two farmers who grew from 61 to 100 lb. of lint per acre, reported an average cost of 26 cents per lb. of lint, and ninety farmers who grew from 101 to 140 lb. per acre reported an average cost of 20 cents per pound of lint.

"More than half the group of 992 farmers had yields of 141 lb. to 300 lb. per acre, with an average production cost of 13 cents per lb. of lint cotton. These farmers were among the group having the larger cotton acreages."

44. FARM CREDIT IN A PLANTATION AND AN UPLAND COTTON DISTRICT IN ARKANSAS. By B. M. Gile and A. N. Moore. (*Bull.* No. 228, 1928, *Agr. Exp. Sta., Fayetteville, Arkansas.*) An analysis of the whole question. From the summary we quote the following: "The costs of seasonal credit to the large plantation farmer compare favourably with similar costs in other regions of the country, but costs of seasonal credit to the small farmer place him at a disadvantage in the sense that farmers in many competing sections are able to control the necessary capital at lower costs. Some of the smaller farmers are no doubt improvident, and possess no basis for independent credit activity. Since the bulk of the credit extended to them is used for current personal consumption, their productive efficiency is not increased as it might be were credit used more largely to gain control over capital goods. Most of the farmers in this class could save something in years of more than normal crop returns, or through greater productivity per individual, without lowering their present living standard. The income from savings thus effected would consequently enable them to raise their standard of living and lower the cost of credit for productive purposes. For this class improvement is likely to come slowly. A definite plan of agricultural education, including the teaching of finance and thrift in the public schools, seems highly desirable."

45. COSTS AND FINANCE IN THE AMERICAN SPINNING SECTION. By E. E. Canney. (Abstr. from the *Text. Rec.*, xlvi., 545, 1928, p. 37.) Deals with the subject under the following heads: War Additions to Costs; Effect of Deflation on Costs; Supplies and Distribution Charges added to Cost ; Cotton Trade Costs; Financial Relief for the American Spinning Section.

46. Soft Cottons. Spinning Tests. (*Nat. Assoc. Cotton Mfrs. Bull.* 98, 1928. Abstr. from *Summ. of Curr. Lit.*, viii., 16, 1928, G. 52.) About 50 per cent. of cottons grown in New Mexico are commonly classed as "soft" by the buyers. The soft cotton is reputed to produce weak yarn of poor spinning quality. Numerous causes are advanced for the production of soft cotton, notably poor irrigation, late picking and alkaline soils. An account is given of tests on nine lots of cotton representing various soils and pickings. The graders in Washington classed all lots as medium in fibre body and normal in strength. This would seem to indicate that late pickings are not necessarily inferior in manufacturing quality. Late pickings show a slight increase in waste over earlier pickings. The weather to which late cotton is subjected is probably a determining factor. Spinning quality, as demonstrated by the amount of waste, and by strength and uniformity of yarns spun from these lots, upholds the classification of these cottons as normal. The soil effect seems to be negligible. The presence of alkali in excess does not appear to injure the cotton fibre or the resultant yarn.

COTTON IN FOREIGN COUNTRIES.

47. "Asiatic Cotton." We have received from the General Cotton Committee, Moscow, a copy of their publication entitled *Asiatic Cotton*, containing a collection of articles (in Russian) of which the following are the translated titles:

A summary of the History of Persian Cotton Growing, its present conditions and prospective development.

Process of Cultivating Cotton on Irrigated Soil of the Persian Highlands.

Economic Position of Herat District in Afghanistan.

Quality of Asiatic Cotton.

Trade of Asiatic Cotton in U.S.S.R.

Kashgar Cotton.

Cotton Growing in Persian and Turkish Districts bordering Russia.

Cotton in Turkey.

Enemies of Cotton in Persia.

Green-fly (*Nezara viridula* L.) a Pest of Cotton on the Southern Caspian Shores of Persia.

48. Report of the Cotton Service for the State of Ceara, Brazil, for the Year 1927. By B. G. C. Bolland. (Copy of the report received from the author.) Great advances were made in the work done by the Cotton Service during the year, owing in a great measure to the support given by the President of the State.

As in previous years, the principal work consisted in the selection and propagation of pure varieties of seed, but since the last report was written much work has been done in the interior of the State by the formation of Demonstration Plots, the registration of gins, and the collection of statistics. Two seed farms were also started.

The Moco cotton, which gave a heavy yield, was valued in Liverpool at 12d. on a day when Middling American was 10·68. Insect pests very considerably reduced the yield of all varieties. *Oxycarenus hyalinipennis* was much more prevalent on varieties such as Moco, with smooth black seeds, than on fuzzy-seeded forms, reducing germination of the former variety to about 30 per cent.

The total export of cotton from the port of Fortaleza was 13,162,432 kilos, of which 7,823,761 went to Rio de Janeiro and 3,838,255 to Santos, presumably for Brazilian consumption; 1,473,182 kilos were used in five factories in Fortaleza (240 kilos equals roughly one bale).

Experiments with manures are described, but owing to the destruction of plants by heavy rains, yields were calculated per plant. Nitrate of soda at 100 kilos per hectare gave the heaviest yield, of 127 grams a plant.

A very complete variety test experiment is being conducted, but needs some years' work to equalize irregularities.

49. COTTON GROWING IN CENTRAL ASIA. (Abstr. *Bank for Russian Trade Rev.*, September, 1928.) From 1917 the cultivation of cotton declined, and in 1922 the area was barely 8·1 per cent. of that of 1915. Since then it has recovered, and in 1927 was 1,998,000 acres. The annual average 1909-13 was 1,556,000 acres. The expansion of cotton-growing has necessitated the formation of co-operative societies and a system of local centres.

50. NEW IRRIGATION WORKS IN CHILE. (Abstr. from *Times Trade and Eng. Supplement*, October 20, 1928.) The Chilean Government has started to carry out a comprehensive scheme of irrigation, which will increase the cultivable area of the country by at least 35 per cent. Among the various schemes put forward is one for the construction of irrigation works at Tarapaca, Antofagasta, and Atacama, where it is proposed to cultivate cotton on an extensive scale.

51. COTTON CULTIVATION IN THE CONGO. (Abstr. from the *Afr. World*, September 9, 1928.) It is expected that the total output of cotton for the year will be approximately 19,000 tons.

52. COTTON GROWING IN THE NEW HEBRIDES AND NEW CALEDONIA. By R. R. Anson, Cotton Specialist, Fiji. (*Attached as Appendix* 3 *to Council Paper* No. 34, 1928, p. 2.) A report on a short visit recently made by Mr. Anson to investigate the French methods of conducting their cotton industry in these islands, and to obtain as much information as possible regarding the Kidney type of cotton, which has been grown in the New Hebrides for some years.

53. RUSSIA. THE TEXTILE SYNDICATE AND THE TEXTILE INDUSTRY OF THE U.S.S.R. We have received a copy of this report from the General Representative Abroad of the U.S.S.R. Finance Commissariat.

From section 1, entitled "The Relative Importance of the Textile Industry," we quote the following in reference to the Textile Syndicate: "The Textile Syndicate is the biggest of all the new Russian economic and trading state organizations. Its annual turnover exceeds 2,150 million roubles; it controls more than 300 factories of the cotton, woollen, linen, silk, and hemp industries. These factories have an aggregate of 8 million spindles, 235,000 weaving-looms, and employ 600,000 workers."

The textile industry is stated to be the most important in the country, and has now reached a productive stage exceeding that of pre-war days. In section 2 an account is given of the part played by the Syndicate in the development of the textile industry.

Section 3 is concerned with the trading activities of the Syndicate. Figures are included showing the rapid growth of production, and an account is given of a new method of trading that has been developed during the last few years, by which the Syndicate concludes "general agreements" of supply with the co-operative societies for long periods.

Section 4 relates to the supply of raw materials. Cotton-growing in Central Asia is increasing rapidly, but raw cotton is still not produced in sufficient quantity to meet the demands of the textile industry, and a large amount is purchased directly in New York, the importation in 1926-27 reaching 650,000 bales.

Sections 5 and 6 of the report deal respectively with the export of textile goods and the financial position of the Textile Syndicate.

54. RUSSIA. *Cotton Cultivation.* We have received copies of the following issues of *Khlopkovoye Dielo*, Nos. 5-6 and 7-8, 1928. This review treats of the

problems of cotton culture, economic conditions, and irrigation of cotton lands in Russia, and is edited by A. E. Akselrod, of the General Cotton Committee, U.S.S.R. Moscow. A large number of papers (in Russian) are included in the volumes, dealing with all the various aspects of the subject, a complete list of the titles in English being given at the end of each book.

CULTIVATION AND MACHINERY : IRRIGATION.

55. THE CLIMATE OF THE AIR NEAR THE SOIL. By R. Geiger. (*Das Klima der Bodennahen Luftschicht*. Brunswick, F. Vieweg and Son, 1927. *Rev. in Met. Ztschr.* (Brunswick), 45, 1928, **2**, p. 74. Abstr. from *Exp. Sta. Rec.*, 59, **5**, 1928, p. 416.) This book is based on studies at field stations of the Bavarian weather service, of what is termed "microclimatology," that is, detailed study by very refined methods of the layer of air lying below the level (1·5 metres or more) at which meteorological observations are ordinarily made. The conditions in this layer of air are considered to be those most intimately affecting plant growth, and constitute what is termed "plant climate." The subjects dealt with are physics of the layer, including temperature variations at different times of the day and night, humidity, and wind movement; orographic and plant relations; and relations to injurious frosts. A bibliography of 267 references is given. This extensive bibliography and the exhaustive treatment of the subject, especially that part relating to plant climatology, makes the book of particular interest to agriculturists, foresters, and botanists, as well as climatologists.

56. CHEMISTRY IN AGRICULTURE. By W. R. Jewell. (Abstr. from *Jour. of Dept. of Agr.*, Victoria, xxvi., No. 7, 1928, p. 385 and No. 8, p. 449.) A popular account of the uses of chemistry applied to agriculture given under the following headings: The Chemical Laboratory and the Farmer; Crops and Soil; Nitrogenous Fertilizers.

57. AN INTRODUCTION TO THE SCIENTIFIC STUDY OF THE SOIL. By N. M. Comber. (New York: Longmans, Green and Co.; London: Edward Arnold and Co., 1927. Abstr. from *Exp. Sta. Rec.*, 59, **2**, 1928, p. 113.) A condensed version of the author's lectures to agricultural students. The contents are as follows: Introduction—the soil and the plant; soil genetics—the mineral matter, organic matter, soil formation processes; soil particles; soil colloids; soil water; soil air; soil temperature; the absorptive properties of soils; soil nitrogen; the mineral plant food in soils; the classification of soils; the artificial treatment of soil; literature of soil science and its use.

58. AN INDEX OF SOIL TEXTURE. By F. Hardy. (*Jour. of Agr. Science*, xviii., Pt. 2, April 11, 1928.)

59. REVIEW OF RECENT GERMAN RESEARCHES ON THE RELATION OF THE MOISTURE CONDITIONS AND MECHANICAL COMPOSITION OF SOILS. (Trans. title.) By J. Zauerbray. (*Izv. Nauch. Melior. Inst.* [*Jour. Sci. Inst. Amelior.*], No. 13, 1926. Abstr. from *Exp. Sta. Rec.*, 59, **2**, 1928, p. 115.) This is a continuation of an extensive analytical review of the subject. The author analyses the Kopecky method for determining the mechanical composition of soils, giving abundant examples both from the actual trials and from theoretical considerations. He also describes the apparatus in detail, and gives directions for conducting the analyses. In the same way the methods for the study of the mechanical analyses of soils by settling and decantation are analyzed. The Atterberg method is taken as the most representative of this type. The author also analyzes the methods which use the settling only as a criterion for the mechanical analyses of soils, using the Zunker method as a representative of this class.

60. The Toxicity to Cotton Seedlings of High Concentrations of Soluble Nitrogenous Fertilizers. By L. G. Willis and E. A. Davis. (*Tech. Bull.* No. 30, *N. Carolina State Coll. of Agr.*, 1928.) The liberal application of nitrogenous fertilizers is essential to the economic production of cotton, and the results of field experiments show that these applications should be made early in the growth of the plants for best results.

The soluble forms of nitrogen are very efficient in practice, but heavy applications may be injurious when applied in too close contact with the seed. Nitrogenous compounds not fixed by the soil, even though properly distributed, may be brought to the surface by the rise of capillary moisture and reach a degree of concentration such as seriously to injure the plants. This effect occurred when applications of nitrates were made in the drill, and there was a deficiency of rainfall in the early season.

Where conditions are controlled, as in carefully conducted pot experiments, the concentration of nitrogen necessary to cause injury is about the same whether this element is supplied in nitrate of soda, sulphate of ammonia, leunasalpeter, or calcium nitrate. Heavy applications of urea are somewhat more toxic than the other forms supplying the same amounts of nitrogen.

The osmotic pressure of the soil solution increases with increased rates of application of all compounds used, being least with urea, the most toxic material, and greatest with the nitrates. Leunasalpeter and sulphate of ammonia gave a pressure intermediate between these two extremes. There is nothing to indicate that injury is in any way associated with the osmotic pressure of the soil solution.

Excepting urea, practically all of the nitrogen added to the soil was recovered in its original form by suitable methods of extraction, and no difference between nitrates and ammonium compounds in their tendency to cause injury was observed.

Growth was normal in pots containing 40 lb. of soil with ·78 and 1·57 grams of nitrogen from all sources. Evidence of injury appeared with the 7·84 gram application of nitrogen ranging from moderate stunting and killing of a few plants with nitrate of soda, sulphate of ammonia, leunasalpeter, and calcium nitrate, to death of all plants receiving this amount of nitrogen from urea. In the smaller applications the urea produced more dry matter than any other form of nitrogen used.

Absorption of nitrogen was rapid during the first four days of growth, being greater when supplied in ammonia compounds than in nitrates. The amount of nitrogen absorbed from each compound was increased with increases in the rate of application. Absorption was greatest when urea was used as the source of nitrogen. The greater toxicity of this material may result from the free ammonia formed by decomposition in contact with the soil, a condition that would probably never occur in the field application of normal amounts of fertilizers.

61. Stimulating the Seeds and Increasing the Yield of the Cotton Plant. (Abstr. from *Jour. of Text. Inst.*, xix., 8, 1928, p. 192.) In Wittmack's *Botanik und Kultur der Baumwolle*, p. 215, reference is made to the experiments of Professor Popoff (Director of the Biological Institute at Sofia University) in stimulating growth and development. These are based upon the fact that vigorous growth largely depends upon respiratory activity—an activity which requires to be awakened, and which can be awakened, according to Professor Popoff, by various chemical stimulants.

The experiments with cotton were carried out in Charmanli (Southern Bulgaria) under Professor Popoff's direction by Mr. Draganoff. The seeds were soaked for ten hours in two different solutions recommended by Professor Popoff, while those used for control were placed for a similar time in an infusion of cow manure, as is customary in Bulgaria. Unfortunately, the exact composition of the stimulating fluids is not given. The seeds were sown on March 25 in ground in which wheat had been grown in the previous year. Both sets of seedlings were cultivated in the same way, and already, on April 24, a considerable difference was seen between the two sets of plants. The stimulated plants were some 9 or 10 inches higher than the control plants, and had leaves of a deeper green colour; they were more largely branched, so that they produced a larger number of flowers. The buds were larger and heavier, and so were the fruits when gathered about the middle of October. The result of harvesting the two sets of bolls showed that the plants which had been stimulated produced 261 lb. of cotton (seeds and lint), while the control plants grown on a similar area only produced 117 lb., which indicates that the result of stimulating the seeds increased the yield by more than 100 per cent.

62. Modern Field Experiments. By T. Eden. (Abstr. from *Trop. Agriculturist*, lxxi., 2, 1928, p. 67.) Deals with the subject under the following headings: The Error Basis of Experiments; The Analysis of Variance; Practical Applications.

63. The Conduct of Field Experiments. By R. O. Iliffe and B. V. Nath. (*Bull.* No. 89, *Dept. of Agr., Madras*, 1928.) Contains useful hints on the subject, published for the benefit of the officers of the Department of Agriculture, Madras.

64. Effect of Spacing on Yield and Size of Cotton Bolls. By H. B. Tisdale. (*Jour. Amer. Soc. Agron.*, xx., 1928, No. 3, p. 298. Abstr. from *Exp. Sta. Rec.*, lix., 5, 1928, p. 435.) In spacing tests with cotton at the Alabama Experiment Station during three years on fertilized and unfertilized land, the largest average yields were made in spacings of 24 and 18 inches in the 3·5 feet row with two plants per hill, or 12,445 and 16,592 plants per acre, respectively. Only small differences were noted in the yields from spacings giving 8,296 and 37,335 plants per acre, respectively. The yield differences from all spacings were less in the extremely dry year 1925 than in 1924 and 1926, which were more favourable. Thick spacing, low fertility, and dry weather evidently caused a decrease in boll size.

65. The Thurman Vacuum Cotton Harvester. (Abstr. from the *Text. Jour. of Aust.*, July 16, 1928, p. 317.) In the letterpress, which is supplied by the U.S.A. Dept. of Commerce, through their Trade Commissioner in Sydney, is given the following description of the Thurman Vacuum Cotton Harvester: The machine carries two vacuum tanks, 22½ inches in diameter by 10 feet long. Inside each tank is attached a removable sack, into which the cotton is drawn by vacuum through the nozzles. The machine has a capacity for six operators, three on each side, each operator working two nozzles, and each having 75 feet of light 1½-inch wire-inserted, non-collapsible vacuum hose, thus enabling the picking of cotton in a square of 150 feet before the machine is moved forward 150 feet and stopped for its next operation. By simply applying the nozzles to the cotton, the cotton is immediately sucked into the removable sack on the inside of the tank. When one sack is full, the operator throws the vacuum lever over, and the vacuum sucks the cotton into the sack in the opposite tank, while the full sack is being removed, thus permitting a continuous operation of cotton picking.

66. Macarthy Gin: Description. (E.P. 293121 of March 31, 1927, Sir W. G. Armstrong Whitworth and Co. Ltd., and B. M. Middleton, Newcastle-on-Tyne. Abstr. from *Summ. of Curr. Lit.*, viii., 20, 1928, E. 57.) In a Macarthy double roller cotton gin or like machine the ginning rollers are detachably mounted in housings at the ends of pivoted arms carrying weights, so that the movement of the rollers is biassed towards the doctor knives. The arms can be raised and supported by movable pins to allow the rollers to be removed. The doctor

knives are adjustably mounted in brackets. The machine may be driven by a belt pulley combined with a clutch operated by a hand lever.

Cf. also abstracts 9, 12, 19, 29, 36, 37, 41, 42, 43, 44, and for soils see also under Chemistry and Physiology, below.

DISEASES, PESTS, AND INJURIES, AND THEIR TREATMENT.

67. The Biological Control of Insect Pests. Projected Work in the British Colonies of Tropical America. By J. G. Myers, Sc.D. (Abstr. from *West India Committee Circ.*, xliii., **781**, 1928, p. 343.) Dr. Myers has been selected by the Imperial Bureau of Entomology to proceed to the British West Indies and British Guiana to deal with entomological matters with special reference to the control of insect pests by the introduction and encouragement of parasites. His appointment has, it is understood, been made possible by the generosity of the Empire Marketing Board. In this article Dr. Myers outlines the research and other work it is proposed to carry out in connection with the control of insect pests by parasites.

68. Is there any Definite Basis for Forecasting Insect Outbreaks and Ascertaining if Control Measures are Practicable? By W. E. Hinds. (Abstr. from *Jour. of Econ. Ent.*, xxi., **4**, 1928, p. 559.) Undoubtedly there are many phases of insect multiplication studies to which the "Theory of Probability" may be applied, and no doubt this will be done increasingly in the near future, but at the present time we do not see how this can be applied in a practical way to certain other phases of insect activity. Meantime, the empirical test of practical experience may be our best guide, and may prove to be of real service in many cases in meeting the problems of insect control most successfully.

69. Bordeaux Mixture. Its Adhesive Power under Egyptian Climatic Conditions. By R. R. Le Geyt Worsley. (*Tech. and Sci. Serv. Bull.* 78, *Chem. Section, Min. of Agr., Egypt.*) A series of experiments has established the fact that the best proportions for a Bordeaux mixture that will adhere well in Egypt are 1 : 0·5 : 50 or 100—*i.e.*, 1 part of copper sulphate to 0·5 part of lime to 50 or 100 parts of water. The mixture should be prepared at a temperature between 15° C. and 30° C., but preferably at as near 20° C. as possible.

70. Cotton Fumigation Plant. (Abstr. from *The Indian Text. Jour.*, xxxviii., **454**, 1928, p. 328.) A Vacuum Fumigation Plant licensed by the United States is operated at Seattle by N. Leckenby. It is capable of handling 100 bales of cotton per hour. Similar plant is in operation at Portland and Astoria, Oregon. It is possible to receive a cargo from an incoming vessel, fumigate it, and deliver it to an intercoastal vessel within twenty-four hours.

71. Cotton Plant Shaker aids War on Boll Weevil. (Abstr. from *Popular Mechanics*, Chicago, September, 1928.) One of the latest units in the battle against the boll weevil is a plant-shaking machine which treats twenty acres a day, and at little expense. The machine is drawn by horses, straddles two rows at a time, and as it passes along the plants are bent and shaken in such a way that infected bolls, trash, weevils, and other insects fall into a pan of oil carried on the machine below. The oil is fatal to the weevils. When the pan is filled, it is easily cleaned and the contents may be burned. Waste oil, such as is drawn from automobile crank-cases, can be used, hence the expense of the treatment is slight. The shaking is said not to damage the plants or the sound bolls. The mechanism that performs the shaking is an elaboration of the hand method of executing the same operation.

72. The Relation of Leaf Colour and Leaf Size to Boll Weevil Infestation. By D. Isely. (Abstr. from *Jour. of Econ. Ent.*, xxi., **4**, 1928, p. 553.)

Field experiments in 1925 and 1926 indicate that the boll weevil has a marked preference for cotton plants with green foliage to those with red foliage. The boll weevil apparently has little choice between small-leafed and large-leafed varieties, provided the size and vigour of the plants are about the same.

73. Para combater a " Broca da Raiz " do Algodao. (A Method against the Root Borer of Cotton.) (*Chacaras e Quintaes*, xxxvii., 2, S. Paulo, 1928. Abstr. from *Rev. App. Ent.*, xvi., 7, 1928, p. 332.) A method of sowing cotton, to be used if infestation of the roots by the weevil *Gasterocercodes gossypii*, Pierce, is probable, has been described by H. A. Tavares. The cotton is sown in continuous rows, which are then thinned so as to leave spaces of 8 inches. If the pest does not appear, the plants are left untouched, but if infestation occurs, the infested plants are unrooted, so that ultimately the plants in the field will be irregularly spaced. If the usual method of having plants at intervals of 32 inches is practised, the removal of infested plants will leave unnecessarily large gaps.

74. A Propos des Faux-Cotonniers Congolais et de Leurs Possibilités Culturales. By J. Ghesquière. (*Rev. Zool. Afr.*, xiv., Pt. 2, 1926. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., Pt. 7, 1928, p. 357.) An account of the silk-cotton or kapok trees (Bombaceæ) of the Belgian Congo, including a list of the insects that have been found attacking them in tropical Africa, the distribution and other food-plants of each being indicated. Of the twenty-two species listed, fourteen attack cotton and seven cacao, kapok being one of the most important food-plants of cotton and cacao pests. For this reason kapok should not be grown in districts suitable for these crops.

75. Annual Report of the Entomologist to the Government, Punjab, Lyallpur, for the Year 1925-26. By R. L. Chopra. (*Rpt. Dept. Agr. Punjab*, 1925-26, Pt. 2, vol. i., pp. 67-125. Lahore, 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., Pt. 9, 1928, p. 419.) *Cotton Pests.*—During March and April the life-cycle of *Earias insulana*, Boisd. (spotted bollworm), on cotton lasted thirty-one to fifty days in the laboratory, as compared with thirty-five to sixty-one days in the field; *E. fabia*, Stoll, is recorded as a pest, but was less numerous than *E. insulana*. An unidentified species of *Earias* taken from *Corchorus* fed on the pods of bhindi (*Hibiscus esculentus*) in captivity, but not on the flower buds of cotton. Trap-crops of *H. esculentus* proved very successful against *E. insulana*, and satisfactory results were obtained by the distribution of the parasite *Microbracon* (*Bracon*) *lefroyi*, D. and G. The eggs of *Platyedra gossypiella*, Saund. (pink bollworm), were collected during October and December, and larvæ were present in some localities from July, 1925, until January, 1926. No seed from infested areas was free from attack, but seed samples that had been ginned by the hand gin were in all cases free. All larvæ are killed by soaking the seed in water at 57° to 58° C. (134·6°-136·4° F.) for five minutes. *H. esculentus* is recorded as a food-plant of this moth for the first time in the Punjab. *E. fabia* and *E. insulana* were parasitized by *M. lefroyi*, *Rhogas testaceus*, Grav., *Brachymeria* (*Chalcis*) *tachardiæ*, Cam., which also attacked *Sylepta derogata*, F. (cotton leaf roller), *Actia ægyptia*, Vill., *Elasmus* sp. and *Apanteles* sp. *M. lefroyi* was bred in small numbers for the first time from *P. gossypiella*, the larvæ of which are also parasitized by *Apanteles* sp. *Sphenoptera gossypii*, Cotes (cotton stem-borer), was observed as early as June in one district, while in another a few eggs and larvæ were observed in October; the extent of attack varied from 1 to 14 per cent.; of two plots, however, which were treated with unslaked lime at the rate of about 5 cwt. to the acre, one was entirely uninfested, and on the other the attack was 0·9 per cent. Minor pests of cotton included *Tarache notabilis*, Wlk., *Xanthodes* (*Acontia*) *graellsi*, Feisth., *Cosmophila erosa*, Hb., *Phycita infusella*, Meyr. (which was parasitized by *M. lefroyi*, *Oncochalcis* (*Chalcis*) *rufescens*, Cam., and *Apanteles* sp.), *Dichocrocis punctiferalis*, Guen., *Myllocerus blandus*, Fst., *Heliothis obsoleta*, F., *Euproctis fraterna*, Mo., *E.* (*Porthesia*) *xanthorrhœa*, Koll., and *Dasychira securis*, Hb.

76. STUDIES ON PLATYEDRA GOSSYPIELLA, SAUNDERS (PINK BOLLWORM) IN THE PUNJAB. By S. S. Bindra. (*Mems. of the Dpt. of Agr. in India*, Entomological Series, x., 6, 1928.) From the summary we extract the following: The facts brought forward go to prove that Pink Bollworm is a serious pest of cotton-seeds in the south-eastern Punjab, but its intensity of attack is successfully reduced in the eastern region, Central Punjab and the northern area, and is least in the Western Punjab, including the Colony areas. It seems likely that the climatic conditions in the Western Punjab are so adverse to the increase of pink Bollworm that it has not been able to attain the status of a pest. On account of the rapid changes that are taking place in the climatic conditions in the irrigated tracts, these tracts at no distant date may, however, become a congenial place for the pest.

As compared with pink bollworm, the spotted bollworm is a minor pest in the south-eastern Punjab; its attack varies between 1·1 per cent. and 3·9 per cent., the main period of its activity being before the middle of September—*i.e.*, a month earlier than that of pink bollworm. The number of bolls affected by a combined attack of pink bollworm and spotted bollworm is very slight, and does not exceed 2 per cent. The attack of both the bollworms on green bolls (bolls actually containing one or more caterpillars, or showing mere signs of damage) reaches 30 per cent. even in the beginning of the season—*i.e.*, towards the end of August. After a period of six weeks—*i.e.*, towards the beginning of October, the attack rises by another 20 per cent. until in the beginning of December 70 per cent. of the bolls are attacked.

The number of pink bollworms infesting an attacked boll is one in August, one to five in September, one to six in October, one to ten in November, and one to nine in December. The attacked loculi contain, as a rule, one pink bollworm in August, one to three in September and October, one to five in November, and one to four in December.

The attack of pink bollworm varies in *kapas* of different pickings; early and middle pickings are generally affected to a moderate degree, whilst late pickings are seriously damaged.

A large number of pink bollworms pass the resting stage in picked cotton. They are mostly found in seeds, but a few are found in lint, either free or in fine silken cocoons. Of caterpillars resting in lint, about 5 per cent. reach the imago stage under laboratory conditions. The moths emerging from these caterpillars show two periods of "rush of emergences"; the first period is during April and May, and the second during July and August. During April and May the cottons are still in the germinating stage in the Punjab, and most probably moths emerging at this time do not contribute towards the damage done to the crop. The second "rush of emergences" is certainly dangerous, because during this period (July and August) the crop is bearing bolls, buds, and flowers, and pink bollworms can find ample food for their development.

The caterpillars resting in seeds are mostly found in two-seeded chambers, a lesser number in three-seeded chambers, lesser still in single-seeded chambers, and least in four and five-seeded chambers. Of caterpillars resting in seeds, about 17 per cent. reach the imago stage under laboratory conditions. The emergence of moths from these caterpillars continues from April to November, but the main rush is during July and the first half of August—the period when the cotton crop is producing bolls in quick succession, and thus provides most suitable conditions for the newly-hatched caterpillars.

The emergence of moths, short and long-cycle, of *Platyedra gossypiella*

Saund., continues throughout the year except for a period of about ten weeks, from January 17 to March 25. The emergence of long-cycle moths continues from April to November, the maximum being in July and the first half of August.

All the pink bollworms present in green bolls before October 7 belong to the short-cycle brood, and after November 21 to the long-cycle generation, while caterpillars present from October 8 to November 20 belong to the short and long-cycle broods. It is sometimes about October 25 that the number of short and long-cycle caterpillars is equal in green bolls. In the present investigation the resting period of pink bollworms is found to vary from twelve to forty weeks.

77. THE COTTON BOLLWORM IN SOUTH AUSTRALIA. By A. M. Lea. (*J. Dept. Agr.*, South Australia, xxxi., 6, 1928. Abstr. in *Rev. App. Ent.*, xvi., 7, 1928, p. 349.) Chiefly compiled from the literature in other parts of Australia and the United States dealing with *Heliothis obsoleta*, F.

78. FIJI: STAINED COTTON AND ITS CAUSES. By H. W. Simmonds. (Abstr. from *Agr. Journ.*, Fiji, vol. i., No. 1, 1928, p. 10.) There are in Fiji two types of stained cotton which are of major importance, and which have caused considerable loss to growers. The first type shows a reddish-brown discoloration of the lint, commencing at the point on the seed which lies closest to the husk of the boll, and spreading in a fan-like manner along the lint fibres. The second, and far more abundant type of stain, is of almost world-wide distribution, and depends upon the attacks of the various cotton stainers of the genus *Dysdercus* for its distribution. This stain is of a very pale yellowish nature, and is generally diffused over the whole area of the affected section of the boll, not starting from a definite point on the seed as the former stain does.

Experiments carried out during the year (1927) showed that:

1. The *brown* stain is produced by *Tectocoris lineola*, and is apparently mechanical, being produced freely by insects reared under cover in captivity.

2. The *yellow* stain, as also many of the cases of rotting and aborting of the bolls, is due to the introduction of fungus spores by *Dysdercus* when feeding, after having previously fed upon diseased bolls, and that although punctures of the bolls and proliferation take place freely when fourth to adult stage *Dysdercus* feed upon cotton, no stain is produced upon the lint as a result of such feeding when clean-fed *Dysdercus* are used.

79. THE COTTON HOPPER AND ASSOCIATED LEAF-BUGS ATTACKING COTTON. By D. Isley. (*Ext. Circ. Coll. Agr. Univ. Arkansas*, No. 231, 1927. Abstr. from *Rev. App. Ent.*, xvi., 7, 1928, p. 320.) During the early summer of 1926 there was a severe outbreak of *Psallus seriatus*, Reut. (cotton hopper), *Lygus pratensis*, L. (tarnished plant bug), and *Adelphocoris rapidus*, Say (cotton leaf-bug), on cotton in Arkansas. The bugs were most abundant in the first month after the setting of squares began; a survey in various parts of the State revealed approximately 30 per cent. injury in the area under cotton. Although the three species were widely distributed over Arkansas, damage was local; *P. seriatus* is a poor flier, and does not spread far from the centre of infestation, but the areas infested by the other two species are less clearly defined, since they are comparatively active fliers. The relative importance of the three species varied from field to field, the injury being most severe where *P. seriatus* was the dominant species, probably because it tends to concentrate its feeding. The only other plants recorded as attacked by it in Arkansas are croton and evening primrose (*Œnothera*). *L. pratensis*, on the other hand, is a well-known pest of a great variety of plants. *A. rapidus* breeds in large numbers on cowpeas and soy beans, and appears to prefer these to cotton. The eggs of *L. pratensis* are laid in the flower buds of composites, and hatch in about ten days, the life-cycle from egg to adult being

completed in twenty-five to thirty days; the life-history and habits of *A. rapidus* are similar, both insects hibernating in the adult stage.

The most important natural enemy of these bugs on cotton in Arkansas appears to be *Geocoris punctipes*, Say, which was previously thought to be a pest of cotton; spiders, mites, Coccinellids and Chrysopid larvæ also feed on all three species. The results of control measures were similar to those obtained in Texas; it is probable that applications of sulphur dust made as soon as infestation is observed will be of the greatest value, and if several are needed, they should be applied at intervals of a week.

80. INVESTIGATIONS ON CONTROL OF COTTON FLEA HOPPER IN 1927. By H. J. Reinhard and W. L. Owen, Jr. (Abstr. from *Bull.* 380, *Texas Agr. Exp. Sta.*, 1928.) Describing the effects of various substances employed as dustings. Electric sulphur, superfine ventilated sulphur, superfine dusting sulphur, and sublimed flowers of sulphur proved the most effective insecticides among the materials used for controlling the cotton flea hopper. The average daily control secured with these grades of sulphur in all tests over fourteen-day periods ranged from 79·6 to 86·7 per cent. Two mixtures of sulphur-tobacco dust "L" grade—viz., 70: 30 and 80: 20, resulted in an average daily control of 71·1 and 74·2 per cent. respectively.

Five new food plants of the cotton flea hopper are listed.

81. IMPORTANT COTTON INSECTS OF CENTRAL PERU. By W. E. Hinds. (Abstr. from *Jour. of Econ. Ent.*, vol. xxi., 4, 1928, p. 545.) During a six weeks' investigation of cotton insect problems in the Canete Valley, located about 100 miles south of the city of Lima, in Central Peru, no evidence was found of the existence in Peru of either the Mexican cotton boll weevil or the pink bollworm. The Peruvian square weevil was found in nearly all fields examined, and ranged from sea level to an altitude of over 2,000 feet. This species attacks only small cotton squares, and causes them to flare and fall to the ground, as do the squares attacked by the boll weevil. The square weevil is a small species, adults measuring from 2·5 to 4 mm. in length. The colour is light tan or brownish, but the integument under the scale covering is brown. The adults are extremely active and shy, and are hard to find in the field, but the flaring and falling of squares betray their presence. Usually only six or eight punctured squares occur on a plant, but sometimes as many as twenty-five were found, these being apparently the work of one female. The development requires some sixteen or eighteen days, and the larvæ and pupæ in fallen squares appear to be quite resistant to heat and drought. It is not known whether the species can survive freezing temperature during its hibernation period.

The most serious cotton pest in Peru seems to be a species of leaf worm. (Possibly more than one species is involved.) This species appears to be native, and occurs abundantly every year, requiring usually three poison applications during the season. At least four generations of this leaf worm must occur. The observations made indicated a developmental period of from twenty-two to thirty days. The multiplication is rapid in spite of the presence of a number of species of predators and parasites. The usual method of control has been arsenate of lead or calcium arsenate sprays applied by knapsack spray pumps carried by Indian workmen. These spraying squads, often numbering over 100 men, do nothing else for three months but spray for leaf worm control. Their work is very inefficient. Dusting has been started to replace the spraying, and has given much better control of the worms, with a very great saving in the time and labour of application. The climatic conditions and the topography of the irrigated valleys are ideal for airplane dusting work, and such work is being started this season in Peru.

Other important insects include several species of small caterpillars which bore into the developing bolls. Their work is followed by the spread of fungus diseases which complete the destruction of the bolls. By this combined attack a damage of from 20 to 25 per cent. to the crop is frequently experienced.

82. ENTOMOLOGY. By H. R. Stewart. (*Rpt. Dept. Agr. Punjab*, 1926-27, Pt. 1, pp. 23-28, Lahore, 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., Pt. 9, 1928, p. 422.) Studies on the Red Cotton Bug (*Dysdercus cingulatus*, F.) are in progress.

83. ENTOMOLOGY. BURMA. By C. C. Ghosh. (*Rpt. Dept. Agr. Burma*, 1926-27, pp. 12-13. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., Pt. 7, 1928, p. 359.) A lygæid bug, *Antilochus coqueberti*, F., was observed to prey upon the red cotton bug (*Dysdercus cingulatus*, F.).

84. ENTOMOLOGICAL HINTS TO COTTON GROWERS. By G. A. Currie. (*Queensland Agr. Journ.*, xxx., 2, 1928, p. 100.)

85. PESTS AND DISEASES OF COTTON IN CENTRAL ASIA. By V. I. Plotnikov. (In Russian.) (*Tashkent, Uzkhlopkom*, 1928. Abstr. from *Rev. App. Ent.*, Ser. A., Pt. 9, 1928, p. 430.) A brief account is given of the pests attacking cotton in Central Asia, with notes on their habits and recommendations for their control. The less well-known pests include *Trifidaphis perniciosa*, Nevskii, which attacks the roots of the young plants, sometimes killing them; cotton should not be sown after potatoes or tomatoes, as this Aphid attacks these plants and also a number of weeds.

86. ST. VINCENT. COTTON PESTS. (Abstr. from the *Rpt. on the Agr. Dept.*, 1927.) The chief pests attacking cotton during the season under review were the pink bollworm and cotton stainer (*Dysdercus delauneyi*). To destroy the former, a Simon's Patent Heater was used at the Government Cotton Ginnery, all seed being heated immediately after coming from the gin shoots. The Heater has sufficient capacity to deal with all seed from the ginnery, and also that from the other one operating in the island.

The campaign carried out for the control of the cotton stainer during the season consisted of (*a*) the enforcing of a close season, (*b*) the trapping of the pests when found in numbers, (*c*) the destruction of food plants.

Other pests and diseases causing damage during the year were the following: Cotton Worm (*Alabama argillacea*, Hubn.), Bush Bugs (*Nezara viridula*); Bronze Beetle (*Colaspis fastidiosa*); *Sclerotium rolfsii*, Black Scale (*Saissetia nigra*); White Scale (*Hemichionaspis minor*), and West Indian Mildew (*Ovulariopsis gossypii*).

87. LOCUST CONTROL. (Abstr. from *Int. Rev. of Agr.*, xix., 6, 1928, p. 575, Rome.) The Drafting Committee of *Material for the Study of Natural Calamities* has passed the following resolution:

In view of—

(1) the present invasion of North Africa by swarms of migrant locusts;

(2) the necessity recognized by all specialists of a scientific study of locusts in addition to the immediate application of control measures recognized as effective;

(3) the necessity that this investigation should be organized by the only qualified international body, namely, the International Institute of Agriculture of Rome,

the Committee endorses the resolution passed by the French Committee for the study of Natural Calamities, which urged the International Institute of Agriculture immediately to request the North African Antiacridian Centre, constituted in accordance with the International Convention of October 31, 1920, to organize in North Equatorial Africa a scientific expedition, directed by

an entomologist, which shall devote itself entirely to the study of the locust problem and the biological questions connected therewith.

***Cf.* also abstract 13.**

88. A CONSIDERATION OF THE PATHOGENICITY OF THE COTTON WILT FUNGUS (*Fusarium vasinfectum*). By H. R. Rosen. (*Phytopath.*, xviii., 1928, p. 419. Abstr. from *Rev. App. Mycol.*, vii., Pt. 10, 1928, p. 630.) Previous experiments having shown that the presence of nitrates in nutrient media causes the production by *Fusarium vasinfectum* of substances toxic to cotton, a series of greenhouse tests was undertaken, the plants being grown in pure quartz sand and in sandy loam soil low in nutrients, and nitrates being added to some of the jars. The average temperature of the house was about 28° C.

In the presence of heavy infestations of the fungus the jars receiving nitrate of soda (at the rate of 1,000 lb. per acre) showed complete inhibition of germination, while no such effect was observed in the two control series—viz., jars with nitrate but no wilt fungus, and those containing the organism but receiving no nitrate.

Considerable difficulty has been experienced by most investigators in the production of typical wilt symptoms by artificial inoculation. This led to a study of the mode of penetration by the fungus and of early disease symptoms.

F. vasinfectum was shown to be primarily an agent of cortical decay in the roots and stem bases, its chief means of entrance being through wounds. It is frequently found producing a limited, more or less superficial rotting of the tissues round the natural wounds induced by extruded secondary roots, and it may also be responsible for the death of elongated feeding roots without penetrating deep enough to cause wilt. The results of field and greenhouse experiments (which are described) denote that *F. vasinfectum* is much more dependent for its toxic action on certain soil factors than are other species of Fusarium. Excessive moisture, unsuitable or unbalanced nutrients, and similar factors promoting succulence and the perpetuation of the juvenile stage are essential to the causation of wilt by *F. vasinfectum*. The development of infection is further facilitated by insect injuries and *Rhizoctonia* lesions which disorganize the tissues and arrest their normal development.

Most varieties of cotton were found to be resistant to wilt when grown under proper conditions, and it is concluded that the disease is largely preventable in America by the use of manure or a green manurial crop.

89. THE INFLUENCE OF ENVIRONMENTAL CONDITIONS ON THE DEVELOPMENT OF THE ANGULAR LEAF-SPOT DISEASE OF COTTON. By R. H. Stoughton. (*Ann. App. Biol.*, 1928, xv., 3. Abstr. from *Trop. Agriculture*, v., 11, 1928, p. 291.) This paper emanates from the Department of Mycology, of the Rothamsted Experimental Station, and describes experiments on the artificial inoculation of cotton plants with the organism *Bacterium malvacearum*, which is responsible for serious loss of crop in many cotton-growing countries. The disease is almost universally distributed throughout the cotton-growing countries of the world, and is particularly virulent in its effects on Egyptian cottons in the Sudan, and also on the native cottons of Nigeria. The disease presents three distinct manifestations according to the part of the plant attacked· (1) water-soaked spots on the leaves which develop into angular lesions delimited by the veins—the "angular leaf-spot"; (2) stem lesions producing the so-called "black-arm" disease; and (3) water-soaked spots on the young bolls producing the typical "external boll-rot." The author obtained all three forms of the disease under glass-house conditions in England by means of varied methods of artificial inoculation. At a humidity above 80 per cent. relative saturation, the limiting temperature for attack of *B. malvacearum* was 32° C., above which infection did not occur. At

70 per cent. relative humidity, infection was slight at 25° C. At lower humidities no infection was obtained at a temperature of 28° C.

The author states that the disease occurs to some extent on all species of Gossypium, though some degree of varietal resistance has been reported. Recent observations in Trinidad indicate that some of the wild species of Gossypium are completely immune. The disease has not been seen so far on *G. Stocksii*, *G. Davidsonii*, *G. Sturtii*. and *G. tomentosum*. The hybrid of Tomentosum by Egyptian shows susceptibility as marked as Egyptian, while the cross of Sturtii by Upland is attacked, though not badly. It appears that susceptibility to the disease behaves as an almost complete dominant. The only cottons which are attacked at all badly in Trinidad are of the Egyptian type, and it has been found easy to isolate from crosses of Egyptian by Upland both relatively immune and susceptible strains. In Trinidad the genetic constitution of the plant appears to be far more important in limiting attack than environmental conditions.—S. C. HARLAND.

(*Cf.* the article in this number by Sir John Russell, p. 8.)

90. COTTON ROOT ROT IN TEXAS. (Abstr. from the *Fortieth Annual Rpt. of the Texas Agr. Exp. Sta.*, 1927, p. 60.) Infection experiments were carried out during the year, the following three methods being tried: (*a*) by infected roots from freshly wilted plants; (*b*) by pure cultures of the fungus; and (*c*) by spores of the fungus. So far the infected roots of freshly wilted plants have given the best results, infection reaching from 70 to 80 per cent. Temperature apparently plays no part in infection.

Considerable work is being carried on with a view to developing strains or varieties of cotton resistant to root rot.

91. CEYLON: COTTON DISEASES. (Abstr. from *Tech. Rpts. for the Year* 1927, *Ceylon*, pp. 2 and 8.) From this report, a copy of which has recently been received, we learn that during the year under review the following diseases were reported as causing injury to cotton: Sore-shin (*Rhizoctonia solani*), Leaf mildew (*Ramularia areola*), and Cotton Wilt (*Fusarium vasinfectum*).

92. BURMA. COTTON DISEASES. By H. F. Robertson. (*Rpt. on the Operations of the Dept. of Agr. Burma, for the year ended June*, 30, 1927, pp. 11-12. Abstr. from *Rev. App. Mycol.*, vii., Pt. 9, 1928, p. 559.) The two fungi associated with internal boll disease of cotton (*Nematospora gossypii* and *N. coryli*) have been found on four other species of wild and cultivated plants. The part played by the red cotton bug (*Dysdercus cingulatus*) remains obscure, but there is little doubt that this insect is a carrier of the disease. In connection with these investigations an internal bacterial decay of Wagale cotton bolls was frequently encountered, its incidence varying from 7 5 to 17 per cent. of the bolls examined. It has also been found to the extent of 21 per cent. on Cambodia cotton. A root disease of Cambodia cotton is under investigation in the Lower Chindwin district.

93. BURMA. MYCOLOGICAL NOTES. Abstr. from *Int. Rev. of Agr.*, xix., 8, 1928, p. 745.) The official correspondent to the Institute, Mr. D. Rhind, Economic Botanist, Mandalay, reports that the following disease is recorded for the first time in Burma: *Kuehneola gossypii* Arth. on Burmese cotton (*Gossypium neglectum*, Tod., var. *burmanica*).

94. WHAT IS "SORE-SHIN"? By M. Shapovalov. (*Phytopathology*, 16, 1926, **10**, p. 761. Abstr. from *Exp. Sta. Rec.*, lix., **2**, 1928, p. 147.) Attention is called to the confusion that is liable to result by designating as sore-shin of cotton only those injuries caused by *Rhizoctonia solani*, as studies made in California and Arizona showed that similar lesions were caused by species of Fusarium and other fungi.

95. BATTERIOSI DEL COTONE. (A Bacterial Disease of Cotton). By C. Sibilia. (*Boll. R. Staz. Pat. Veg., N.S.*, viii., **1**, 1928, p. 93-96. Abstr. from *Rev. App. Mycol.*, vii., Pt. 9, 1928, p. 577.) Towards the end of 1927 the author received from the Italian Protectorate of Erythrea, on the Red Sea, a cotton plant preserved in alcohol, showing lesion on the stem, branches, and boll (no leaves were present), in the diseased tissues of which an organism which was identified as *Bacterium malvacearum* was abundantly present.

96. BELGIAN CONGO: FUNGI AND INSECTS NEW TO THE COLONY. By P. Staner. (*Int. Rev. of Agr. N.S.*, xix., **4**, 1928, p. 399. Abstr. from *Rev. App. Mycol.*, vii., Pt. 9, 1928, p. 562.) The following fungi new to the Belgian Congo are recorded: *Cercosporella gossypii*, causing the development of whitish patches on cotton leaves; *Marssonia* (*Marssonina*) sp., causing a brown discoloration of the veins of cotton leaves; and *Melanostroma* sp., forming its fructifications on cotton leaves previously discoloured by its mycelium. (All the cotton diseases at Ubangi).

97. ASPERGILLUS NIGER, INFLUENCE OF TEMPERATURE ON. By Rudolf Meyer. (*Biochem. Z.*, 1928, **198**, 463-77. Abstr. from *Summ. of Curr. Lit.*, viii., **20**, 1928, A. 32.) The author discusses theories and attempts to obtain mathematical expressions for growth. Studies of the influence of temperature on the development of *Aspergillus niger* are described. Curves are given showing dry weight against time of growth at different temperatures on culture media containing different amounts of nitrogen. The curves show maximum weight values after different times of growth. The maximum-value time is a minimum at temperatures in the region of 30° C. Comparisons of the maximum-value time and the half-value time variations with temperature show that the variations of the quantities are not parallel. The course of the curves depends also on the amount of nitrogen source used. Discussing the results, the author points out the need for more exact definition, and shows that such terms as "optimum temperature," "maximum yield," and "greatest velocity of growth" are only relative terms. The research conditions should be stated when using these terms.

98. ASPERGILLUS NIGER. ACID FORMATION BY. By K. Bernhauer. (*Z. Physiol. Chem.*, 1928, **177**, 86-106. *Biochem. Z.*, 1928, **197**, 278-342. Abstr. in *Summ. of Curr. Lit.*, viii., **16**, 1928, A. 23, and **19**, 1928, A. 29.)

99. ASPERGILLUS NIGER, ACID FORMATION BY. By K. Bernhauer and H. Wolf. (*Z. Physiol. Chem.*, 1928, **177**, 270-9. Abstr. in *Summ. of Curr. Lit.*, viii., **20**, 1928, A. 32.)

100. CONDITION D'HYPOTONIE DES CELLULES AFFECTÉES PAR LA MOSAIQUE (Hypotonic Condition of Cells affected by Mosaic.) By J. Dufrenoy. (*Comptes rendus Soc. de Biol.*, xcviii., **17**, 1928, p. 1499. Abstr. from *Rev. App. Mycol.*, vii., Pt. 10, 1928, p. 660.) The cytological examination of epidermal fragments of mosaic-infected leaves shows a vesicular modification of the plastids and mitochondria of the diseased areas. The staining of the vacuoles by neutral red is very irregular in the discoloured areas as compared with the healthy ones. Tests showed that the cells of the mosaic tissues are in a hypotonic condition.

Cf. also Abstracts 5, 21, 27.

BREEDING, GENERAL BOTANY, ETC.

101. COTTON BREEDING. By S. B. Jackson. (*Cotton*, **92**, 1928, 898-99. Abstr. from *Summ. of Curr. Lit.*, viii., **19**, 1928, A. 28.) A report of a lecture on cotton breeding and its relation to spinning, in which the author emphasizes the importance of planting pure strain seed. Figures are given showing the proportion of cotton of different staples in the crops produced in Texas and Oklahoma, and in Georgia. About 20 per cent. was "untenderable."

102. Some Precautions observed in Picking Single Cotton Plants for pure Line Work. By T. Trought. (Abstr. from *Agr. Jour. of India*, xxii., 6, 1927, p. 459.) This note is written to call attention to the real danger that exists of stray locks from adjacent plants being included with the cotton picked from a single plant selection, which is intended to be the parent of a pure line family. It is considered possible that the locks may be brought in by birds, or if plants are growing close together there may be some interlacing of branches, with the possibility that a lock from one plant may get caught and pulled out of the boll by some projection on the neighbouring plant. Such stray locks would almost inevitably be included by the picker when picking the plant unless definite precautions were taken to avoid this.

The author describes the method in use for picking single plants of pure lines. Calico bags are used with a double compartment, one side being for natural locks, and the other for self-bred locks. The dividing partition projects somewhat from the mouth of the bag. In picking a single plant, two men gently hold back the adjacent plant, leaving the plant to be picked well separated from the others. A third man picks first the naturally fertilized bolls, and stringent instructions are issued that only locks which are actually in place in the boll are to be picked; these must come from the "heel" of the boll. For the self-fertilized bolls, these are all labelled at the time of selfing, and the whole boll and peduncle is picked with its label, into the "selfed" compartment of the bag. These are checked later in the laboratory, and an opportunity is thus given of detecting and even retrieving mistakes.

103. A New Variety of Cotton from China. By J. B. Griffing. (*J. of Hered.*, vol. xviii., No. 11, 1927, p. 496. Abstr. from *Int. Rev. of Agr.*, xix., 8, 1928, p. 723.) The new variety, known as the "Million Dollar," is the progeny of a single plant discovered by the writer in 1919 at Woosung, near Shanghai. Whereas the common Chinese cotton has three locks, the "Million Dollar" under favourable conditions has over 60 per cent. of the bolls with four or five locks. The lint is from 1 to $1\frac{1}{16}$ inches in length, remarkably soft, fine, white, and of high breaking strength. The lint percentage ranges from 31 to 33; the lint index (grams per 100 seeds) from 4 0 to 4 5; the weight of 100 seeds from 8 to 10 grams. This variety can thus be favourably compared with American Upland, and with Trice, an American cotton acclimatized in China.

104. Trellising Cotton. A Convenient Method of Handling Breeding Plots. By G. J. Harrison. (*J. of Hered.*, 19, No. 7, 1928, p. 325.) Cotton tends to rank growth in the irrigated valleys of the South West, and trellising it with a single strand of stretched wire has proved very useful in preventing the mingling of the plants.

105. The Fruiting Habits of the Cotton Plant. By T. S. Buie. (*Jour. Amer. Soc. Agron.*, xx., No. 3, 1928, p. 193. Abstr. from *Exp. Sta. Rec.*, lix., 5, 1928, p. 434.) Factors involved in the production of fruit in the cotton plant have been studied by the South Carolina Experiment Station with particular reference to environmental factors concerned with earliness.

Flowers blooming early in the season at Clemson College seemed to have a much better chance of developing into open bolls than those appearing later. The peak of flowering was attained during the fifth to sixth week of fruiting under conditions prevailing from 1923 to 1925. It was noted that varieties producing a large proportion of their fruit early in the season bore few flowers

late in the season, and *vice versa*. Plants from early plantings took longer to begin fruiting, but produced more flowers early in the season. Closely spaced plants fruited early, although not necessarily bearing more bolls. A greater reproductive activity was stimulated by removing the flowers.

Further studies at the Pee Dee Substation, supplementing those reported by Warner (*cf.* Abstr. 65, vol. v., of this Review), indicated that phosphorus seems to hasten the fruiting of the plant. Nitrogen on the particular soil did not have much effect in stimulating the production of early fruit as compared with cotton on infertile soils. Potassium under the conditions prevailing increased the number of flowers borne before midseason, and slightly decreased the percentage of total yield obtained at first picking.

106. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d., post free.) These Memoirs will appear in two series—A. Genetics; B. Physiology—and each series will be numbered consecutively. The first number of series B., Physiology, has recently been issued, and contains the following papers reprinted from the *Annals of Botany.*

STUDIES ON THE TRANSPORT OF CARBOHYDRATES IN THE COTTON PLANT. By T. G. Mason and E. J. Maskell.

I. *A Study of Diurnal Variations in the Carbohydrates of Leaf, Bark, and Wood, and of the Effects of Ringing.* A summary of this paper has already been included in vol. v. (see Abstract No. 342, p. 206.)

II. *The Factors Determining the Rate and the Direction of Movement of Sugars.* The aim of the work reported in the present paper was to obtain information concerning the laws governing the transport of carbohydrates in the cotton plant. The methods employed consisted essentially in the determination of the amounts of carbohydrate moving under specified conditions, and of the concomitant variations in space and time of sugar concentration in the conducting tissues.

The general conclusion is reached that longitudinal transport of sugars takes place mainly in the sieve-tubes, and is, except as regards absolute rate, analogous to movement by diffusion. Interchange between the leaf and the bark, the bark and the boll, the bark and the wood, and between the sieve-tubes and the parenchyma of the bark, also appears to follow a diffusion pattern.

107. STUDIES IN GUJARAT COTTONS. Pt. V. VARIABILITY IN CERTAIN ECONOMIC CHARACTERS, PARTICULARLY IN SEED WEIGHT AND WEIGHT OF LINT PER SEED IN PURE STRAINS OF BROACH-DESHI COTTON. By M. L. Patel and H. H. Mann. (*Mems. of the Dept. of Agr. in India*, Botanical Series, xv., 7, 1928.) The conclusions that have been reached regarding the causes of the variability of seed-weight and lint-weight per seed in pure strains of Broach-deshi cotton are as follows:

1. The seed-weight and lint-weight per seed from flowers opening on a single day are a little less variable than from the whole of the flowers of a strain. This does not account, however, for more than 10 per cent. of the total variability for lint-weight, and for more than 12 per cent. of the total variability for seed-weight.

2. The time required for the maturation of the boll would seem to be distinctly but feebly correlated with the seed-weight, though the relationship may easily be swamped by seasonal factors. As regards the lint-weight per seed, the time required for maturation of bolls also affects the weight, and in fact, to a greater extent than with seed weight. This may also be largely swamped by seasonal factors, as occurred at Surat in 1924-25.

3. The kind of branch on which the bolls are borne has no relationship with the seed-weight, while with the lint-weight per seed the position is doubtful.

There is evidence, however, that the bolls arising indirectly from primary monopodia give less lint per seed than other bolls from the same plants. The variability within the produce from primary fruiting branches is higher than that from other branches.

4. There seems a definite relationship between the length of internodes on the branches, and the seed-weight and lint-weight per seed on the bolls borne at the succeeding nodes. The seeds from bolls borne after long internodes are heavier and the lint-weight per seed is also greater.

5. The number of seeds in the boll (except in extreme cases) has not given a clearly marked effect on the seed-weight and weight of lint per seed, except in certain strains (*e.g.*, Selection II.).

6. Seeds from four-celled bolls are usually somewhat lighter than those from three-celled bolls. The lint weight per seed is, however, slightly greater in the case of four-celled bolls. The connection is not, however, very certain in the latter case.

The above conclusions relate to an early stage of the enquiry; the results reached in the later part of the investigation are now added. These mainly concern the effect of the position of a boll in connection with the scaffolding of the cotton plant on the seed-weight or the weight of lint per seed of the cotton produced. This question of position relative to the general structure of the plant seems a very important factor in determining the variability of the characters studied. Generally, there seems a marked tendency for both the characters to decrease in the later developed parts of the plant, and in the younger parts of branches. This is specially marked in the case of sympodial branches. The extent of decrease is also very high on this kind of branch. This leads one to conclude that a type of plant should be preferred which has numerous short sympodia rather than the one which has a limited number of long fruiting branches.

There is another important point besides the variation and the extent of variation above stated—viz., whether the change in the seed-weight and the weight of lint is similar, or, in other words, whether the ginning percentage remains constant. No definite conclusion may be reached, but there seems to be a tendency for the lint-weight per seed to diminish faster than the seed-weight—*i.e.*, for the ginning percentage to be less on the younger parts of shoots. The strains differ as to this feature, and certain among them, notably I-A Cylindrical Boll and B.D-4, show the opposite tendency, particularly the former.

Out of the several characters studied for variation from boll to boll, it is concluded that the weight of seed-cotton per boll varies the most, while the maturation period varies the least.

108. COTTON. EFFECT OF SELF-POLLINATION. By G. L. Kottur. (*Nature*, **122**, 1928, 314. Abstr. from *Summ. of Curr. Lit.*, viii., **19**, 1928, A. 28.) Kumpta cotton (*Gossypium herbaceum*) yielded in 1915 one pure strain which has since been continued by the use of selfed seed. During the last season the strain was thoroughly examined for height of plants, total length of limbs, sterility of the anthers, shedding of flowers, number of bolls per plant, yield of seed cotton per plant, ginning percentage, staple length, and seed weight. There was no deterioration in any of the above characters, so that apparently twelve years' selfing has no injurious effect in cotton. The explanation of the fact that a variety sometimes yields more than its pure line which is selected for yield is to be found in the hybrid vigour of the F_1 plants appearing in the open pollinated seed of the variety, not in the deterioration of the selection due to selfing.

In connection with the above article the following note from J. B. Hutchinson, Assistant Geneticist, Cotton Research Station, Trinidad, appeared in *Nature* of November 10, 1928: "In *Nature* of September 1, 1928, p. 314, Mr. G. L. Kottur distinguishes between 'the deterioration of a selection due to selfing' and 'the hybrid vigour of the F_1 plants.' Surely, on whatever theory we interpret hybrid vigour, both phenomena are manifestations of it. To attribute to hybrid vigour the greater yield of a variety over its pure line selected for yield is therefore illogical if it is maintained that there is no reduction in vigour on selfing."

109. THE TOUGHNESS OF COTTON BOLLS IN RELATION TO AGE AND NUTRIENT SUPPLY AS MEASURED BY PRESSURE TESTS. By G. M. Armstrong. (Abstr. from *Jour. of Agr. Res.*, **36**, No. 12, 1928, p. 1011.) Cotton boll size, wall thickness and toughness, as measured by resistance to needle puncture, have been studied on bolls of several ages from different varieties grown under two conditions of fertility. The tests were conducted during three seasons of growth.

There was an increase in toughness of boll wall to about twenty-one days, at which time the bolls had practically attained their full size. After this time the age of the boll was not a chief factor.

The conditions during the developmental period probably influence the relative toughness of walls, as shown by the generally more tender bolls in the later series of 1926 contrasted with the tougher bolls in some of the late series of 1924.

The conditions of fertility may be reflected in the resistance to puncture if the contrast in fertility conditions is sufficiently great.

Varietal differences in toughness of wall are evident, though not constant. Bolls of Webber were toughest late in the season of 1924, and in general throughout the seasons of 1925 and 1926. The relative toughness of the bolls of Dixie Triumph and Cleveland 12 at different ages was variable.

The bolls of Webber are, in general, largest and the walls thickest.

No close correlation was found between boll size, wall thickness, or wall toughness, and the percentage of cotton loss from boll-weevil attack as studied by Fenton and Dunnam.

110. PLANT PHYSIOLOGY. (*New Jersey Sta. Rpt.*, 1927, p. 30. Abstr. from *Exp. Sta. Rec.*, lix., **4**, 1928, p. 321.) Investigations of the influence of light intensity on the H-ion concentration of plant tissue fluids.

111. COTTON HAIR SECTIONS. CUTTING. By J. Kisser. (*Faserforschung*, 1928, **6**, 233-238. Abstr. from *Summ. of Curr. Lit.*, viii., **16**, 1928, A. 23.) A technique for cutting very thin cross and longitudinal sections of cotton hairs is described. Cross-sections up to 4μ thickness can be obtained by embedding in paraffin and cutting with an oblique instead of a square-set knife, and to obviate difficulties due to the sections rolling in on the knife the blade is wetted with water containing soap or gelatin. Longitudinal sections up to 2μ thickness are prepared by the celloidin-paraffin method, using a small cardboard frame to stretch the hairs before embedding.

Cf. also Abstracts 16, 33.

CHEMISTRY AND PHYSICS IN THEIR APPLICATION TO COTTON PROBLEMS.

112. A COMPARATIVE STUDY OF THE METHODS OF PREPARATION OF THE SOIL FOR MECHANICAL ANALYSIS, WITH A NOTE ON THE PIPETTE METHOD. By A. N. Puri and B. M. Amin. (*Bull.* 175, 1928, *of the Agr. Res. Inst. Pusa.* Obtainable from the Govt. of India Central Publications Branch, Calcutta. Price As. 4, or 5d.)

113. DYE ADSORPTION BY HYDROUS ALUMINA IN SOILS. By H. H. Croucher. (*Jour. of Agr. Science*, xviii., Pt. 2, April 11, 1928.)

114. THE MEASUREMENT OF "SUCTION FORCES" IN COLLOIDAL SOILS. *By* F. Hardy. (*Soil Science*, xxiv., No. 1, July, 1927.)

115. THE DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF THE AQUEOUS EXTRACT OF SOIL AS A RAPID MEANS OF DETECTING ITS PROBABLE FERTILITY. By A. Sen. (*Mems. of the Dept. of Agr. in India, Chem. Series*, ix., 8, 1928. Obtainable from Govt. of Ind. Central Pubns. Branch, Calcutta. Price As. 4, or 6d.)

116. CLEANING MACHINES. WASTE PRODUCED. (*Cotton*, 1928, **92**, 915-6, Texas Textile Assen. Abstr. from *Summ. of Curr. Lit.*, viii., **19**, 1928, F. 40.) The results of tests made in six mills on the percentage of waste taken out at the different opening machines are tabulated.

117. OPENING MACHINE. DESCRIPTION. By L. Schorsch. (E.P. 292472 of June 18, 1927. Goerkau, Czecho-Slovakia. Abstr. from *Summ. of Curr. Lit.*, viii., **19**, 1928, F. 40.) In an arrangement for removing from fibrous material both the impurities which are loosely mixed with it, and those which adhere to the fibres, the material is fed by a hopper feeder to a beating machine and is transferred by an intermediate feeding device to the apron of a cleaning machine delivering to cages. In the cleaning machine the apron delivers to a feed roller and pedals, or to two feed rollers. The material may pass continuously through two sets of beating and cleaning machines, or the cleaning machine may be duplicated. The cleaning machine may deliver to a device which lays the fleece transversely in overlapping folds on an apron leading to a lap roll.

118. COMBINATION OPENING PLANT. DESCRIPTION. (Saco-Lowell Shops, *Text. World*, 1928, **74**, 847-9. Abstr. from *Summ. of Curr. Lit.*, viii., **20**, 1928, F. 42.) The machine consists essentially of a feeder, two Buckley sections, a second feeder, and a blade section. A rake is located in the second or intermediate hopper, and is connected through suitable linkages to the shipper of the cone belt, which controls the speed of the first feeder. The control of the stock level in the intermediate hopper is thereby made automatic, and any variation is compensated for by a variation in the feed of the first feeder and feed rolls. The rolling action of the stock against the rake is claimed to prevent lap formation, and aids in giving the desired mixing effect necessary for proper blending. An evener before the blade beater in turn controls the speed of the second feeder. The new single process saves labour and gives a lap of improved quality. An extract is given from the *Saco-Lowell Bulletin* describing in detail the development of the one-process opener.

119. SETZER OPENER. DESCRIPTION. By Rud. Mitter. (*Leipziger Monats. Text.-Ind.*, 1928, **43**, 322-4. Abstr. from *Summ. of Curr. Lit.*, viii., **20**, 1928, E. 42.) The machine has a large drum and a smaller drum excentrically arranged within it, both drums revolving with the same circumferential speed and carrying carding needles having the same spacing. The needles are tangentially arranged so that they penetrate vertically a cotton lap fed by a feed roller. The needles of the large drum are grooved, and the needles of the small drum, which have a circular cross-section, catch in the hollow channel The needles penetrate the lap together, then with further rotation of the drums the needles of the inner drum separate from those of the outer drum, and in so doing draw out and open the cotton at a speed which is only a fraction of the circumferential speed of the drums, so that there is no danger of damage to the cotton. The mass of fibre is retained by the needles of the outer drum, a clearer roller being provided to remove any fibre adhering to the inner drum. The cotton is subsequently combed and stripped by carding rollers and carried forward by a current of air to a sieve drum, where it is formed into a lap for the carding engine. The rate

of opening of the cotton increases with the difference in diameter of the drums. For short material which is more easily opened, the inner drum can be smaller ***than for long material.***

120. THE FOUNDATION OF YARN-STRENGTH AND YARN EXTENSION. Pt. I. THE GENERAL PROBLEM. Pt. II. THE RELATION OF YARN-STRENGTH TO FIBRE-STRENGTH. By A. J. Turner. (*Bull.* No. 12, *Tech. Ser.*, 7. *Indian Central Cotton Committee*, 1928.) *Part I.*—It is pointed out that ultimately the values which may be obtained for the strength and extension of a yarn depend on (1) the fibre characters, (2) features of yarn structure, (3) sampling methods and errors, and (4) the conditions of testing.

Part II.—Reference is made to the question whether yarns break by fibre-fracture or by fibre-slippage; full extracts from the works of Monie and Bowman are given to show the work which they each carried out and the views they held, and a short account is also included of the work of Miss G. G. Clegg.

The following factors, which appear to be the cause of the deficiency of actual yarn-strength, as compared with that calculated from the fibre-strength, are discussed in the light of the knowledge available:

(1) In testing yarns for strength the fibres are tested as groups.

(2) In a yarn the fibres lie spirally.

(3) The torsional forces arising from twist in a yarn may weaken the fibres under tension.

(4) Towards their ends the fibres in a yarn do not bear a load equal to their strength.

(5) Only part of a fibre is tested in the fibre-strength test.

(6) Imperfect yarn structure resulting from (i.) variation of count, (ii.) imperfect mixing of the fibres, (iii.) variation of twist, and (iv.) imperfect " lie " of the fibres.

(7) Inequality of stress distribution between the axial and superficial fibres.

It is pointed out that these weakening factors are to some extent counterbalanced by a pseudo-strengthening factor due to the fibres being non-uniform, as a result of which the doubling together of the fibres may cause the weak places in some fibres to be supported by strong places in others.

From a consideration of the combined effects of all these factors, the conclusion is drawn that the yarn-strength must depend in some manner on the fibre-strength; and that while it is not at present possible to assign definite magnitudes to these various factors, it is yet easy to understand why only a small proportion of the strength of the fibres is apparently used in a yarn even when the breakage of the yarn is due at least as much to fibre-fracture as to fibre-slippage.

121. THE EFFECT OF DIFFERENT SPINDLE SPEEDS ON THE RESULTS OF SPINNING TESTS. By A. J. Turner. (*Bull.* No. 14, *Tech. Ser.* No. 9, *Indian Central Cotton Committee*, 1928.) All the yarns spun in the present tests have been within the spinning capacities of the cottons; the results obtained at the high spinning speed are identical with those at the low spinning speed. Hence there is every justification for using the higher spindle speeds in the spinning tests on the standard Indian cottons. For the reasons given it is clear that if a cotton is being spun near its spinning limit, an increase of spinning speed will cause an increase in the number of spinning breakages, owing to the increase caused in the winding-on tension. Unevenness of yarn has to be avoided not only because of its intrinsic undesirability, but also because it leads to more spinning breakages and a lessened production; any factor contributing to unevenness should therefore be avoided. Excessive speed in machinery may cause the rollers to vibrate in their necks and " pluck " at the roving; this will cause unevenness in the yarn, and consequently more spinning breakages: thus there is a mechanical limit to the speed of the ring frame, though this limit will of course be higher for machinery in good condition. But if the counts of yarn being spun are well within the limits of the capacity of the cotton, there is no disadvantage in spinning at the highest possible speed, for an increased production is then obtained without any sacrifice of the good qualities of the yarn.

122. THE EFFECT OF USING UNBALANCED DRAFTS INSTEAD OF BALANCED DRAFTS IN THE SPINNING PREPARATION FOR SPINNING TESTS. By A. J. Turner. (*Bull.* No. 15, *Tech. Ser.* No. 10, *Indian Central Cotton Committee*, 1928.) From the tests made on no less than eight cottons of widely varying character, the conclusion is reached that a comparatively wide variation is possible in the series of drafts used in spinning tests without affecting to any appreciable extent the results obtained. The usual procedure at the Technological Laboratory of spinning three different counts (20s, 30s, and 40s) from one set of rovings is completely justified; and it follows that in a mill where it is occasionally necessary to spin counts decidedly higher or lower than the customary, but where it is not worth while laying down a special mixing for the different counts, it is possible to obtain the higher or lower counts merely by changes in the ring frame. This means that a great deal of time can be saved by not making any changes in the preparation machinery for the change of counts.

123. COTTON WASTE SPINNING. ENGLISH AND CONTINENTAL METHODS. By J. Reed. (Abstr. from the *Jour. of Text. Inst.*, xix., **10**, 1928, P. 205.) An interesting paper read by Mr. J. Reed, of Messrs. Platt Bros. and Co., Oldham, at the Autumn Conference of the Textile Institute held at Bury. Mr. Reed advocates greater attention to the cotton waste which lies ready to hand for everyone, and which can be spun into yarns of quite useful nature.

124. THE TENSION IN A SINGLE WARP THREAD DURING PLAIN WEAVING. By A. E. Owen. (*Shirley Inst. Mems.*, vol. vii., August, 1928.)

125. THE RELATION BETWEEN ATMOSPHERIC HUMIDITY AND THE BREAKING STRENGTH AND EXTENSIBILITIES OF TEXTILE FABRICS BEFORE AND AFTER WEATHERING. By A. J. Turner. (*Jour. of Text. Inst.*, xix., **4**, 1928, T. 101.)

126. BLEACHING COTTON FABRICS: BLUE BENDER COTTON. By W. Scholes. (*Text. Merc.*, 1928, **78**, 148-9. Abstr. from *Jour. of Text. Inst.*, xix., **8**, 1928, A. 286.) A report of a lecture and discussion on the bleaching of cotton piece goods. One of the chief problems is the bleaching of cloth containing cheap low-grade cottons, often of the "blue bender" type. The lecturer considers that there are possibilities in relation to this class of cotton, and that the discovery of an effective method of dealing with it would make a real contribution to the solution of certain problems of the weaving industry.

127. THE CHEMICAL ANALYSIS OF COTTON. XVIII. THE DETERMINATION OF CELLULOSE BY OXIDATION WITH CHROMIC ACID. By C. Birtwell and B. P. Ridge. (*Shirley Inst. Mems.*, vol. vii., August, 1928.)

128. THE CHEMICAL ANALYSIS OF COTTON. XIX. THE ACTION OF SODIUM HYDROXIDE SOLUTIONS ON MODIFIED COTTON CELLULOSE AT THE ORDINARY TEMPERATURE. By C. Birtwell, D. A. Clibbens, and A. Geake. (*Shirley Inst. Mems.*, vol. vii., August, 1928.)

129. COTTON SEED PRODUCTS. MOISTURE ESTIMATION. By W. H. Irwin. (*Oil and Fat Ind.*, 1928, **5**, 124-9. Abstr. from *Summ. of Curr. Lit.*, viii., **19**, 1928, B. 96.) A study has been made of a modified Kingman distillation method and of an oven method, using a jacketed oven with a glycerol solution in the jacket and electrically heated, for moisture determinations on cotton seed, meal, and cake. A sketch of the oven, with practical details, is provided. It is recommended that the jacketed oven method be adopted as standard, the drying time to be fixed at three hours. It is suggested that the Kingman distillation method be used in special cases where, for any reason, a distillation moisture method appears advisable.

130. A SIMPLE METHOD FOR DETERMINING THE OIL CONTENT OF SEEDS AND OTHER OIL-BEARING MATERIALS. By D. A. Coleman and H. C. Fellows. (*U.S. Dept. Agr. Tech. Bull.* 71, 1928. Abstr. from *Exp. Sta. Rec.*, lix., 5, 1928, p. 415.) The procedure here proposed is that of Wesson (*Cotton Oil Press*, 4, No. 3, 1920, p. 70) with some modifications of the technique. Wesson's method consists essentially, as summarized in the present paper, of the treatment of a weighed quantity of the cottonseed meats or ground meal with a definite quantity of the solvent for a time sufficient to insure solution of the oil, after which a filtered portion of the oil solution is examined in a refractometer, the oil content being read off from a standard table prepared for this purpose. It is stated that the necessary solvent characteristics were found in an impure monochlornaphthalene known to the trade as halowax, grade No. 1000 or No. 1007. A specific gravity of approximately 1·25, a boiling point of 350° C., with a refractive index of approximately 1·63500 at 25°, are assigned to this preparation, and it is said to have a low coefficient of expansion and to be non-inflammable.

The adaptation of the method to other oil-bearing seeds is reported.

Cf. also Abstracts 6, 22.

CO-OPERATION.

131. CO-OPERATIVE MARKETING. By Dr. H. Sinha. (Abstr. from *Trop. Agriculturist*, lxxi., 2, 1928, p. 101.) Includes sections on the work of the American Cotton Growers' Exchange, the Marketing of Cotton in India, and Cotton Sale Societies in India.

LEGISLATION.

132. SOUTHERN RHODESIA. GOVERNMENT NOTICE No. 597 of September 7, 1928, cancels Government Notices Nos. 86 of 1923, and 289 of 1921, and restricts the importation of cotton and cotton seed into Southern Rhodesia except under permit granted by the Minister of Agriculture and Lands, and subject to such restrictions and conditions as he may deem necessary.

133. SPAIN. Information received from the Dept. of Overseas Trade is to the effect that the *Madrid Gazette* of October 3 published the text of a Royal Decree numbered 1662, and dated September 29, providing for the renewal, for a further period of five years, of the credit of two million pesetas annually granted by Royal Decree of October 11, 1923, for experimental cotton cultivation in Spain.

134. TANGANYIKA TERRITORY. GOVERNMENT NOTICE No. 72 of May 17, 1928, enacts that every purchaser of cotton grown by natives in the Morogoro or Kilosa districts shall pay a fee at the rate of a half cent per kilogram for all cotton purchased by him. Such fee to be paid to the District Officer at the end of every fourteen days after the date of the commencement of cotton buying at markets, accompanied by a return giving the total quantity of cotton, in the different qualities, purchased in such period.

135. TANGANYIKA TERRITORY. GOVERNMENT NOTICE No. 73 of May 23, 1928, enacts that the fees set forth in the Schedule to the Cotton (Fees) Rules, 1927, shall be payable for the year ending March 31, 1929.

136. **Uganda.** **The Cotton (Care of Cotton Plots) Rules, July 3, 1928.** These rules provide that should a chief be of opinion that any cotton plot is in such a condition that it is harbouring or is likely to harbour insects harmful to cotton, or that it is or is likely to be a cause of disease to neighbouring cotton plots, he may direct the occupier of such plot to do what is necessary to remedy such dangerous condition. Failure to comply with such request without reasonable excuse is punishable by fine.

137. West Indies. St. Lucia. (Abstr. from the *Rpt. on the Agr. Dept., 1927,* p. 12, recently received.) To prevent the introduction of dangerous pests and diseases into St. Lucia, the following prohibition is in force in regard to cotton:

"Cotton seed and all parts of the cotton plant are entirely prohibited except under licence, and subject to heat or fumigation treatment on arrival."

MISCELLANEOUS.

138. The British Cotton Industry Research Association. *Report of the Ninth Annual General Meeting.* After a general introduction by the Chairman, Mr. Kenneth Lee, in which among other things he itemized the need for greater financial support, Dr. Pickard, the Director of Research, gave a general account of the aims and policy of the staff of the Institute. He stated that they were endeavouring to increase the efficiency of every process, and to reduce as much as possible to figures what had hitherto been "the experience of the practical man." (This is the general tendency with all applications of science, and is strikingly shown in the way in which science is catching up in agriculture with the experience of generations of agriculturists.) Dr. Pickard went on to give examples of the way in which the work of the Institute was proving of great benefit to the practical worker.

ERRATA.

Cotton in the Punjab. By Trevor Trought. Vol. v., p. 230, line 27, for "without *leaf* spot," read "without petal spot"; p. 231, heading of table, line 2, for "1905" read "1925"; p. 235, line 5, for "30° C." read "36° C."

PUBLICATIONS RECEIVED

We have to acknowledge the receipt of the following publications for the Library.

From the Research Station, Long Ashton, Bristol.

SWARBRICK, T.: *Factors Governing Fruit Bud Formation:* VIII. The Seasonal Elongation Growth of Apple Varieties on some Vegetative Root Stocks, and its Possible Relation to Fruit Bud Formation.

SWARBRICK, T.: *The Healing of Wounds in Woody Stems:* II. Contributions to the Physiological Anatomy of Ringed Apple Shoots.

SWARBRICK, T.: *Studies in the Physiology of Fruit Trees:* I. The Seasonal Starch Content and Cambial Activity in One- to Five-Year-Old Apple Branches.

SWARBRICK, T.: *Studies in the Physiology of Fruit Trees:* II. The Effects of Ringing, Double Ringing, and Disbudding upon the Starch Content and Cambial Activity of Two-Year-Old Apple Shoots.

From the Welsh Plant Breeding Station, University College of Wales, Aberystwyth.

Series C., No. 1, Season 1920: "I. Variety Trials with Oats."
"II. Rust Resistance Trials with Wheat."
"III. Incidence of Fungus Diseases on the Cereal Plots."
"IV. Appendix; Variety Trials with Oats in the Counties."

Series C., No. 3, Season 1921-22: "Preliminary Investigations with Oats." By Martin G. Jones.

Series H., No. 3, Season 1920-23: "Seasonal Productivity of Herbage Grasses." By R. G. Stapledon.
"The Nutritive Value of Grasses as shown by their Chemical Composition." By T. W. Fagan and H. T. Jones.
"Productivity of Different Strains and Nationalities of Red Clover." By R. D. Williams.
"A Note on Subterranean Clover." By R. D. Williams and W. Davies.
"Grassland and the Grazing Animal." By R. G. Stapledon *et al.*

Series H., No. 4, Season 1921-24: "Studies concerning the Pollination, Fertilization, and Breeding of Red Clover." By R. D. Williams.

Series H., No. 5, Season 1925-26: "The Animal Complex and the Pasture Complex." By R. G. Stapledon *et al.*

Series H., No. 6, Season 1923-26: "Seeds Mixture Problems." By R. G. Stapledon *et al.*

Series H., No. 7, Season 1919-26: "Red Clover Investigations." By R. D. Williams.

Series H., No. 8, Season 1921-28: "Seeds Mixture Problems: Competition." By R. G. Stapledon and W. Davies.

From Estados Unidos Mexicanos, Secretaria de Agricultura y Fomento.

Boletin Mensual, Nums. 6 y 7, Junio y Julio de 1928.

PERSONAL NOTES

APPOINTMENTS.

In addition to those mentioned in the October issue of the Review, the following holders of Senior Studentships last year have received appointments as under:

Egypt.

Mr. R. I. Nel has received an appointment in the Plant Protection Section of the Ministry of Agriculture, Egypt.

Northern Rhodesia.

Mr. W. Allan, who was reported in the last issue as having been appointed Agricultural Entomologist in Jamaica, has in place of that appointment accepted an entomological post at the Government Agricultural Experiment Station, Mazabuka, Northern Rhodesia.

Tanganyika.

Mr. R. M. Maynard has secured an appointment as a District Agricultural Officer in Tanganyika.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes " home " on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the colonies.

At the date of writing, the following officers are on leave in England from cotton-growing countries:

Fiji	Mr. E. Whittenbury.
Gold Coast	Mr. R. Coull.
" "	Mr. W. T. O. Maidment.
" "	Mr. B. T. Steemson.
Nigeria	Mr. W. B. Dowson.
Sierra Leone	Mr. D. C. Edwards.
Tanganyika	Mr. L. C. Edwards.
"	Mr. C. B. Garnett.
Uganda	Mr. E. G. Staples.
"	Mr. R. T. Wickham.
Zanzibar	Mr. J. R. P. Soper.

The following officers of the Corporation's staff abroad are on leave in this country:

Nyasaland	Mr. H. C. Ducker.
Southern Rhodesia	Mr. J. E. Peat.

Printed in Great Britain by Billing and Sons Ltd., Guildford and Esher.

THE
EMPIRE COTTON GROWING REVIEW

VOL. VI. APRIL, 1929. NO. 2

COTTON IN CEYLON

F. A. STOCKDALE, C.B.E.,
Director of Agriculture, Ceylon (retired).

The earlier efforts at the cultivation of cotton in Ceylon were made in the North Western and North Central Provinces. Fair crops were raised, but difficulties were experienced with insect pests and with the uncertain and irregular rainfall in those Provinces. Small trials inaugurated by the Ceylon Agricultural Society indicated that greater success was to be expected in the Hambantota district of the Southern Province, and the following brief account of the work in that Province during the past seven years records the experiences gained.

An Experiment Station of sixty acres, subsequently extended to seventy-two acres, was opened at Ambalantota in the Hambantota

Averages of—	*Liangahatota* (*14 Years*).		*Mamadola* (*33 Years*).		*Ambalantota* (*6 Years*).		*Hambantota* (*59 Years*).	
	In.	*Days.*	*In.*	*Days.*	*In.*	*Days.*	*In.*	*Days.*
April	4·46	10	5·09	9	1·76	3	3·25	8
May	3·21	8	3·15	8	3·65	6	3·20	8
June	1·81	8	2·61	9	3·36	8	2·40	9
July	2·64	7	2·21	7	2·45	6	1·75	7
August	1·14	3	1·21	4	0·94	5	1·23	6
September	2·72	7	2·82	8	3·70	8	2·50	8
October	7·23	13	6·30	12	4·89	9	4·80	11
November	8·92	15	6·99	13	6·21	11	6·88	13
December	6·92	12	6·68	11	4·84	8	5·34	10
January	3·73	9	3·74	7	4·59	6	3·52	7
February	1·41	4	1·95	4	1·58	3	1·43	4
March	5·91	10	3·55	7	3·58	9	2·50	6
Total	50·10	106	48·30	100	43·35	82	38·80	97
September to February	30·93	60	28·48	55	25·81	45	24·47	53

district in 1921, and smaller stations were subsequently established at Embilipitiya, Bata-ata, Middeniya, and Dabarella. Embilipitiya is situated within the Province of Sabaragamuwa, but with the exception of a higher rainfall its climate approximates to that of the Hambantota district. The rainfall returns for stations in the Hambantota district are given on p. 101.

The actual rainfall returns during the cotton-growing season (September to March) for the years 1921-1928 at Ambalantota Experiment Station have been as follows:

	1921-1922.	1922-1923.	1923-1924.	1924-1925.	1925-1926.	1926-1927.	1927-1928.
September	—	0·23	9·35	4·95	0·52	2·48	4·31
October..	5·15	5·77	6·38	2·70	7·61	6·13	1·14
November	2·43	4·61	8 41	3·50	6·46	8·16	5·75
December	3·24	1·29	7·36	2·27	11·77	2·15	4·58
January	0·64	4·20	3·15	6·14	8·62	4·81	3·03
February	2 20	2 71	1·17	0·90	Nil	2·50	0·98
Total for season ..	13·66	18 81	35·82	20·46	34·98	26·23	19·79
March	2·56	0 85	9 08	6·86	0·81	12·15	1·50

The rains in September are required for cultivation preparatory to sowing, whilst heavy rains in January bring about flower-bud and boll shedding, and rains in March spoil the quality of the picked cotton. The Ambalantota Experiment Station is situated on a heavy alluvial soil, and in consequence the best yields of cotton have been secured during dry years. The soil is heavier than the bulk of the soils on which cotton has been grown in the district. These soils range from sandy loams to clays, but in general require a heavier rainfall than Ambalantota for maximum crop production. In all cases the top soils overlay subsoils of clay, and these subsoils retain moisture satisfactorily. Where the soil proper is shallow, water-logging is noticeable during the rainy season, and such areas have naturally to be avoided for cotton cultivation.

CULTURAL WORK.

The work at Ambalantota has included a series of cultural trials. Tractor ploughing and harrowing have been carried out during various seasons, as well as ploughing and cultivation with cattle-drawn implements. As the result of these trials it has been established that work can be done more economically by means of cattle than by tractor power, and that if the best results are to be secured, early ploughing is desirable. The cotton harvest of the first picking is completed before the end of April, and during the months of April-July there is generally sufficient rain to make cultivation operations possible. The implements found the most suitable are Ransomes' Victory and Ceres ploughs, followed by tooth and disc harrows. The Victory plough is suitable for average seasons, but in some years and on some lands it is not sufficiently heavy, and a heavier type of plough is required. It is, however, the plough most suited for the type of animals available, although in some cases the Ceres has proved to be the more satisfactory, as the local animals are generally small. It has been the aim of the trials to select a plough which was capable of satisfactory work under average circumstances, and yet within the draught capacity of a pair of bullocks. The Victory plough can be satisfactorily employed with large animals, whilst the Ceres plough must be used when only small country animals are available. If advantage is taken of the showers which fall, the Victory or Ceres ploughs give reasonably satisfactory results, and a good tilth can be secured by means of tooth or disc harrows. The former have been used when cleaning was necessary, and the latter for average cultivation. Intercultivation has been done with Planet Junior cultivators. Weed growth has been very heavy, and it will be necessary in regular cotton cultivation to provide in the rotations for cleaning crops, and possibly for bare fallows. Cotton will not tolerate weeds, and satisfactory growth is not secured if weeds are not kept well in check.

VARIETIES.

Trials have been made on the Experiment Station with a number of varieties. These have consisted of tests of Sea Island, Egyptian varieties, American Uplands, and short staple Indian Karunganni. The yields from Sea Island cotton amounted to 630 lbs. of seed cotton per acre during the 1921-22 season, and to 236 lbs. during the following season. It was found that this variety took too long to come to maturity in the Hambantota district. American Upland varieties, grown from seed introduced from South Africa and from the United States of America, gave yields varying from 100 lbs. up to 1,014 lbs. of seed cotton per acre. In the first year yields were satisfactory, but subsequently they fell very considerably, and the Jassid population increased and became responsible for a fair amount of damage. The most promising type has been an early maturing type of Durango, and its cultivation was [illegible] on a small scale [illegible] work. The yields of [illegible] staple Karunganni cotton were 1,492 lbs. of seed cotton in [illegible], but only 58 lbs. per acre in the subsequent year. The type of cotton which it was decided to concentrate upon was the Cambodia cotton grown largely in the Madras Presidency. Seed supplies of pure strains produced by the Madras Department of Agriculture were secured. Yields have varied very considerably, and have ranged from 87 lbs. of seed cotton per acre in the 1926-27 season, to 659 lbs. in the 1921-22 season. There seems to be a progressive falling off in yields, but data on this point have not yet established anything definite as to the cause of this fall, as climatic conditions have been variable from year to year, and the weed factor has similarly varied from season to season. In some years it has been possible to control weeds easily, but in others the rains have so fallen as to make cultural operations for the control of weeds difficult, and at times impossible. Trials have also been made to test crop yields of seed freshly imported each year as against crop yields of the local seed, but the records so far obtained give no definite indications worthy of mention.

Mass selection work has been carried out for the general seed supply to cultivators, and special selection work has also been commenced. The progeny of selfed plants are being tested with a view to securing types of high-yielding capacity suited to the conditions of the district. Seed of a hairy Durango was secured in 1926-27, but unfortunately none of this seed germinated. A further search is being continued in all Durango cotton grown with a view to establishing, if possible, a Durango cotton which will be Jassid resistant. Early maturing types are required. There is a tendency towards excessive vegetative growth in Ceylon grown cotton, and in consequence, special selection is necessary if a fully satisfactory type is to be secured.

PESTS AND DISEASES.

Pests and diseases have not been serious. Some damage to crops has been done by elephant, but this has not been excessive. Pink and spotted bollworms (*Platyedra gossypiella* and *Earias fabia*) exist, but have not done any material damage, as second pickings are not remunerative, and all cotton is uprooted as soon as possible after the first picking is completed. The leaf-eating caterpillar, *Cosmophila erosa*, has done some damage, but can be readily controlled by dusting with Paris Green. It is a pest which may in certain seasons cause trouble, as it feeds normally on the malvaceous weeds of the district,

FIG. 1.—COTTON AT THE EXPERIMENT STATION, AMBALANTOTA: DUSTING WITH PARIS GREEN TO CONTROL ATTACKS OF *Cosmophila erosa*

FIG. 2.—PURCHASING COTTON AT MIDDENIYA STORE.

and one of these ([illegible]) is very common and most persistent. A leaf roller (*Sylepta derogata*) is common in some seasons, and causes more damage to the Cambodia than to other varieties. At times it is serious enough to require hand picking, but generally it is not responsible for losses of crop. Jassids occur, but not in the quantities found in some cotton-growing countries. They must, however, be expected to show an increase in numbers with any extension of cultivation, and in consequence Jassid-resistant types of cotton must be grown if success is to be secured.

ROTATION CROPS.

If cotton cultivation is to become permanently established in the Hambantota district, it must form part of a definite rotation in a regular system of agriculture. Experimental work to test out suitable rotations has been undertaken at Ambalantota, Bata-ata, and Middeniya, and the results have been fully recorded in the reports on the work of these stations.

Trials have been made with several varieties of the following CEREALS: Maize (*Zea Mays*), Sorghum (*Sorghum vulgare*), Adlay (*Coix Lachryma-Jobi*), Elwi or hill paddy (*Oryza latifolia*), Tana (*Setaria italica*), Kurakkan (*Eleusine coracana*), Mineri (*Panicum miliaceum*), and Amu (*Paspalum scrobiculatum*).

Good crops of maize have been secured, but at times damage has been done to them by elephant. Sorghum has also grown well, and produced good crops. The loose-headed types have been found to be the most suitable, and the darker-grained varieties appear to be more satisfactory than the white types, which are often badly attacked by parrots and other birds. Adlay grows well, and produces good crops during wet seasons. Hill paddy has not so far given satisfactory results, and has produced crops only during wet seasons; it appears to require under Ceylon conditions a minimum of 40 inches of rainfall during its growing period. Kurakkan has given good crops in some seasons, and yields have been heavier when grown on heavy soil. The belief of the inhabitants that kurakkan can be grown only on new land has been proved to be false, for good crops of kurakkan can be successfully raised if no excessive weed growth occurs during the early stages of growth. A yield of 28 bushels of kurakkan per acre was secured during one season at Ambalantota from land which had carried cotton continuously for five years, and gave a profit of Rs. 52 per acre. Tana has generally given satisfactory results, whilst mineri can be used for a short crop at the end of the season, and is particularly suited to light soils. Amu can also be grown if sown late, but yields from the crop have not been high.

Of LEGUMES, trials have been made with the following: Dhall (*Cajanus indicus*) has been experimented with, but yields have not been satisfactory, as the flowers are seriously damaged by the blister beetle (*Zonabris pustulata*); cow-peas (*Vigna catjang*) grow magnificently, and are most useful as a clearing crop, but they do not produce heavy crops of grain; black gram (*Phaseolus Mungo* Linn.) gives steady crops in most seasons, whilst green gram (*Phaseolus aureus* Roxb.) produces satisfactory crops in dry years and if sown late in the season. It crops very poorly if it is in flower or in fruit in a wet period, and during wet seasons often produces practically no crop at all. Groundnuts (*Arachis hypogœa*) have also been tried, and are suited to the lighter lands, on which they give good yields.

MISCELLANEOUS CROPS. The most profitable crop undoubtedly is chilli. Nurseries are established in August, and the seedlings put out at distances of 3 feet by 2 feet or 3 feet by 2½ feet in October. By the sale of green and dried chillies profits of Rs. 176 per acre have been realized. Another profitable crop is tomato, if transport facilities exist for the disposal of the crops. Tomatoes likewise are sown in nurseries in August, and the seedlings transplanted in October. Profits of Rs. 70 per acre have been obtained from this crop. Gingelly (*Sesamum indicum*) grows satisfactorily, and produces profitable crops in certain seasons. It appears to be rather uncertain in its cropping in the Hambantota district, and cannot be grown—as it is in many other parts of Ceylon—as a crop after cereals in the so-called Yala season from April to June.

FODDER GRASSES. The most promising fodder grass appears to be *Pennisetum cenchroides*, but it is also possible that *Paspalum commersoni* may eventually be found to be suited to certain areas.

PEASANT CULTIVATION.

Shifting cultivation, known locally as chena, is the only cultivation in the Hambantota district on dry lands, except for small areas of garden cultivation and tobacco cultivation under well irrigation. This shifting cultivation is regulated by Government, and definite areas are given out annually on permit. Additional areas were provided for cotton cultivation, and prices for seed cotton grown were guaranteed. The seed cotton was purchased by the Ceylon Spinning and Weaving Mills in Colombo, and was collected and paid for by officers of the Department of Agriculture, acting as the Government agents of the purchasing firms. Cash for seed cotton was paid to the growers themselves, and the rates were fixed for certain definite centres—due allowance being made for repacking and transport to the Colombo market. The cotton seed has been supplied to the growers by the Department of Agriculture, and in this way control over seed supply has been maintained throughout. The quantities of peasant-grown seed-cotton in the different sections of the Hambantota district have been as follows:

	West Giruwa Pattu.	*East Giruwa Pattu.*	*Magam Pattu.*	*Total.*
	Cwts.	*Cwts.*	*Cwts.*	*Cwts.*
1923-24	25	647	38	710
1924-25	22	1,039	164	1,225
1925-26	32	2,010	658	2,700
1926-27	28	1,485	394	1,907
1927-28	91	1,329	484	1,904

The year 1926-27 shows a fall in crop owing to the very unseasonable rains in the early months of 1927, and excessive boll and flower shedding, whilst 1927-28 crops, which promised well in spite of the late rains, fell below expectations owing to further shortage of rain during the latter period of growth.

The financial aspect of the cotton produce scheme is shown by the following table:

	Value of Cotton produced.	*Actual Payments to Growers.*
	Rs.	*Rs.*
1923-24	18,202·81	11,957·41
1924-25	30,733·40	23,815·58
1925-26	55,225·42	45,513·59
1926-27	38,830·31	31,592·35
1927-28	34,262·86	30,541·14
	177,254·80	143,420·07

The difference between the totals represents the cost of transport of seed to the growers, the cost of transport of the cotton crop to Colombo, and the cost of travelling of Government officers during the actual purchase of the crops.

The yields of seed cotton grown by peasants have varied from 1½ cwts. to 7 cwts., and even 9 cwts. per acre. Cultivation has, in general, been satisfactorily carried out, and the importance of weeding has been realized. The growers are keen on the crop, but would welcome some system of hypothecation of crops during the growing period. Cotton cultivation can, however, be of permanent value only if it becomes part of a system of crop rotation. This will necessitate larger holdings and a promise of title to the lands so opened and cultivated. This is the line of development which is now being followed up, and the experiment stations at Bata-ata and Middeniya are designed to demonstrate the possibilities of a system of crop rotation in which cotton will be the main money crop. The question of a ginnery has been taken up, and private enterprise is now erecting a ginnery with saw gins at Ambalantota. Negotiations for the ginning at this ginnery of the 1928-29 peasant crop are now in hand.

CONCLUSION.

In conclusion, it may be stated there is no doubt that cotton can form a useful rotation crop in a system of agriculture suitable for the drier areas of Ceylon. Cambodia cotton can be satisfactorily grown, but early maturing types are required, and special selection of seed must be continued so that high-yielding types suited to the conditions of Ceylon are secured. Attention has so far been concentrated on the Hambantota district, but a beginning has during the past two years been made in other areas where cotton cultivation promises to be successful. The slump in cotton prices has introduced a complication in these trials, but so far the Government of Ceylon has met a part of this fall in values in order that a reasonably stable price to the growers may be maintained. The progress so far made in the Hambantota district has been due to the devoted work of the Divisional Agricultural Officers, Messrs. Burnett, Harbord, and Lester Smith, who have had charge of the supervision of the work throughout, and to the members of their subordinate staff, who have worked whole-heartedly for the furtherance of these cotton-growing investigations.

Received October, 1928.

THE FUNCTIONS OF AN AGRICULTURAL OFFICER IN THE TROPICS

An Address delivered at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, 6th January, 1929.

BY

SIR JAMES CURRIE,
Chairman of the Governing Body of the College.

It is a great pleasure to be here, and to have an opportunity of meeting you all. I welcome, in particular, Sir Francis Watts, our first Principal, and take his presence as a great compliment. To see the College, to have an opportunity of grasping its objectives, of understanding its difficulties, of beholding the evolution of schemes which have been laboriously discussed both by the Governing Body and by the Staff here, make me thankful that at last I have been able to make this journey.

I sometimes wonder if the amount of time, labour, and thought that has been put into the founding of this place, or the high hopes that are entertained for it, or the difficulties that have been surmounted in calling it into being, are fully realized. Great administrators such as Lord Milner and Lord Lugard; distinguished Governors of these islands, Sir John Chancellor, Sir Samuel Wilson, Sir Horace Byatt; Cabinet Ministers like the Duke of Devonshire, Mr. Thomas, and Mr. Amery; men of science such as your first Chairman, Sir Arthur Shipley, Sir David Prain, Sir John Farmer, Professor Wood Dr. Hill; men of business like Sir William Himbury, Mr. Moodie Stuart, Sir Edward Davson, have given their brains and their time without stint to your service.

Colonial Governments and Colonial taxpayers—first, foremost, and most liberally, the Governments and Planters of the West Indian Islands—have contributed to our funds. The British taxpayers, as represented by the Imperial Treasury and the Empire Marketing Board, have done and are doing their full share. Crown Colonies and Dominions are beginning to realize what the College may mean to them, and have begun to contribute. Great British industries, such as the users of cotton and the makers of sugar machinery, have given liberal aid; so have also some Banks and private firms.

Now, though the work of creation is still far from complete, a beginning has been made, and your founders look to you, in full confidence that you will justify their plans, their hopes, and their visions.

When considering what I should say to you this morning, I reflected that the majority of your number are not undergraduates, but men, and men who have already given proof of more than average capacity and industry. I speak on the assumption that you are convinced of the importance of the profession you have adopted, and that you believe implicitly in the possibilities of your work.

These possibilities we have attempted to make as broad as possible. The Governing Body and the Staff here have set themselves to build up an Institution which will be a centre alike of teaching and research. We try to avoid duplicating work which can be efficiently and more economically carried out at home.

We are convinced, however, that, in the main, tropical problems must be studied in a tropical environment. We consider that the average University graduate has experienced rather a surfeit of lectures, and that he has reached a stage at which direct instruction is profitably supplemented by actual association with specific pieces of research under the guidance of experienced workers.

The majority of the Professorial Staff have got important work in hand, in which you are privileged to share. So has the Cotton Research Station of the Empire Cotton Growing Corporation, which is at your door. The Empire Marketing Board also realize that the College furnishes a convenient centre from which much important investigation can be conducted, and you are thus provided with additional facilities for the observation of high-class research, if you are worthy of being infected with its spirit. We welcome members of the Agricultural Staffs of various Colonies. We hope that they benefit by their term here, and, in any event, you learn much from them as regards the conditions under which you will have to live and work.

I believe that, in the main, during the twentieth century, it is your type of work and its results that will justify some measure of alien guidance in the Tropics. Be not deceived; such guidance is on its trial today. Tested by the success that has attended our efforts to place scientific methods at the service of those who look to us for help, we British people have but moderate ground for satisfaction. We have concentrated on administration; we have lacked faith in what science has to give us.

I have talked recently to two friends, each holding a high official position, each recently returned from extensive Empire tours. Both of them have had unique opportunities of arriving at correct conclusions. They have both told me that, among much to justify legitimate pride, they blushed when they contrasted the economic development, based on scientific and medical research, in countries within the orbit of the British Empire, with the state of things obtaining under many foreign flags. I would like to cite another and different type of witness. I wonder if most of you have read a book I brought with me on the voyage out, and found most interesting reading. It is a collection of fugitive essays on scientific subjects, and has been given the title of "Possible Worlds." The author is Mr. J. B. S. Haldane, now of Cambridge University. The object he has set before himself is, in his own words, that the average man should attempt to realize what is happening today in the Laboratories. In one brilliant essay—"Nationality and Research" is the name the author gives it—he tells us that in Europe two small nations, Holland and Denmark, lead in the output of scientific work per million inhabitants. He adds that they are, incidentally, two of the healthiest nations in Europe, and are both quite rich, though almost devoid of mineral wealth. This is because they are successfully employing biology; Denmark to her own Agriculture, Holland to the development of her Empire, which sets the example to the world in Tropical Agriculture and Hygiene.

Now, I am not content to read such criticism, especially since I entertain no doubt as to its truth. It is all very well to talk about British Administration and its excellence, the integrity of British justice, and the historic glories of the Privy Council. A hungry population intent on a much higher standard of living cannot exist on such things, indispensable preliminaries to social well-being though they are.

To listen to many eminent officials, one would almost think that political institutions were ends in themselves. I wrote to a distinguished tropical administrator the other day, and told him that I would yet find his subjects starving amid political perfection. I think he considered the criticism blasphomous.

But, even in much preoccupied Great Britain, there has been a stirring on the face of the waters, and an increasing comprehension of vital needs. More has been done in the Colonial Office during the last five years than in all its previous existence to make up the costly leeway, thanks, in the main, to the present Secretary of State and his enthusiastic and informed Parliamentary Secretary, Mr. Ormsby Gore. A few years ago a strong Committee, presided over first by Lord Milner, and on his death by Lord Lovat, was set up to take stock of the situation, and the result was a remarkable document called the Lovat Report. If its recommendations can be carried into effect, a great weakness and a great reproach will be removed.

I need not draw attention to the political and financial difficulties that will have to be surmounted before adoption is possible. One tangible result has already happened. Mr. Stockdale, known to many in Trinidad, and now, I am glad to say, a Governor of the College, is installed in the Colonial Office as Assistant Agricultural Adviser.

I do, however, state without fear of contradiction, that if the Report, as a whole, were adopted tomorrow, the Staff does not exist to man the various services and Research Institutions which are indicated as essential. It is to you and to your successors that we, in the main, look to fill this gap worthily. The whole tropical world is calling; no Christian missionary, Jesuit, Moravian, Presbyterian, or Anglican, no Mohammedan sheikh, no Buddhist Mahatma, ever has had a greater opportunity presented for work and sacrifice. And this is an appeal to you all, undergraduates and post-graduates alike.

And the particular fascination of the work is that it benefits not only the particular people among whom the worker's lot is cast, but the whole world fabric. Take a case in point. I have seen, during the last twenty years, arid lands south of Khartoum redeemed from barbarism and destructive fanaticism, caused in the main by degrading poverty. A contented population is now putting these lands to productive use, primarily to their own benefit, but in a scarcely less degree to that of the workers of Bolton or Lyons.

I will not, however, talk further on the direct possibilities of the work that is going on here. If you did not agree with me you would not be in Trinidad today.

Before I conclude, I am going to say one word on some of what I may term the extraneous difficulties that many of you will certainly encounter, especially in the later stages of your careers. When I talk of scientific problems and the application of the scientific method outside certain narrow limits, I walk by faith and not by sight. When I talk of political and administrative difficulties, I feel on surer ground. At all events, what I say is the outcome of thirty years' work and experience.

What I would urge you to remember is this, that if, in the various spheres of work to which you will shortly be transferred, you fail to keep alive and sensitive to the problems, administrative and political, industrial and agrarian, with which the East is seething, your work will be shorn of much of its possibilities of usefulness.

Have you ever asked yourselves what are the *ultimate objects* that a College like this exists to serve?

The late Lord Morley, in a magnificent address which he gave some years ago to the students of Manchester University, suggested that a primary object of their University was " to weave the strands of knowledge into the web of social progress." If you accept that as an adequate definition, you cannot attain your maximum usefulness unless you provide yourselves with a working knowledge of the history, the political and economic conditions, and, if possible, the language of the particular country in which you find yourself at work. Do not hug the illusion that the political and economic questionings which are troubling Africa and Asia are passing phenomena, or that you will be unaffected by them. The problems that today confront India and Ceylon will tomorrow face West Africa and the Sudan. My own view is that, in the near future, in many parts of the British Empire, great changes will be seen so far as the organization of scientific work is concerned. If the Lovat Report be adopted, a good deal else may in time follow. State Departments of Agriculture organized on bureaucratic lines may be transformed. The antiquated Pension system may disappear in favour of something more elastic. Research and administration may in time be grouped round Institutions which the Report proposes to set up, and conceivably round various great industrial organizations, such as the Empire Cotton Growing Corporation and the Rubber Growers' Association.

These institutions and organizations, though liberally supported by the State and the various Governments concerned, will be independent and free. State action will limit itself to co-ordinating effort. By some such means I would hope that the support and interest of the people among whom they work may be assured, with beneficial reactions in all directions. Otherwise there is a real danger that scientific work may become identified with particular theories of political or racial ascendancy.

In that case, as changes take place in methods of government, the toll that politics takes of economics may be heavy indeed. This has already happened in Egypt, to the detriment of the material interests of the community. Of India I have scanty knowledge, but I have read the Linlithgow Report, and I know a little of the rise and, I fear, of the partial decline of the magnificent Imperial Department of Agriculture which Lord Curzon inaugurated.

All such recent events will repay your study. The recent Report on Ceylon is available, and the Report of the Simon Commission, when it appears, will be of supreme interest. Much, too, may be learned from a study of the policy followed by the Dutch in their magnificent Empire in the East, with its fifty millions of people.

In this connection, Mr. Ormsby Gore's Report on his recent Far Eastern tour is well worth careful reading. The Hilton Young Report on conditions in East Africa has probably appeared by now.

Finally, it is unnecessary to remind you, the majority of whom are heirs to the traditions of British Universities, that research knows no colour bar, and that a distinctive feature of British University life has been the absence of nationalistic feeling.

What the contribution of the East may be in the future to the cause of research is (again to quote Mr. Haldane) veiled from our sight. Japan, with such work only in its first generation, is already up to the level of most European countries. China, under American guidance, is starting, and India has fairly begun. It has already produced one of the outstanding mathematical figures of the twentieth century. And all over Africa and Asia foundations are being laid; in Beyrouth, in Palestine, in Khartoum, in Ceylon, in Singapore, to take examples known to me.

While the first and paramount duty of each of you is to become a master of his own craft, a comprehensive understanding of the problems I have touched on is no less essential. Equipped intellectually and technically, as I have tried in these few words to indicate, you will be fitted to take part in the task on the success of which the material, moral, and spiritual progress of the human race in no small measure depends. That task is the justification of the West in the eyes of a questioning and awakening world.

RESEARCH AND AGRICULTURE

BY

H. MARTIN LEAKE, Sc.D.

In the October number of this review, Mr. Hewison has raised the question of the relation of Scientific Research to Agricultural Departments, and he suggests that a discussion of the question will not be without profit. The importance of the question thus raised is beyond doubt, since on its correct solution depends in large measure the orderly progress of Colonial development. Mr. Ormsby Gore has gone so far as to place the application of science to the problems of production among the most important functions to which a Governor could turn his mind (speech at the luncheon of the Royal Colonial Institute to Sir Edward Denham on October 18, 1928). Research, too, if it is to consolidate the position it has won for itself in recent years as a weapon adequate to the purpose of solving the many practical problems of agriculture, is intimately concerned that the answer may be correctly given. I offer the following remarks as one who, though firmly convinced of the utility and need of such research, recognizes that many, and important, interests have not this same firm conviction, and that to these research is still on its trial. The present-day attitude towards research is, in fact, in many respects similar to the attitude towards alcoholic beverages. That attitude is not uniform. To one, exemplified by the mathematician who added at the foot of his solution to an intricate problem the remark, " Thank goodness, this has no practical application," research is as vintage port, to be drunk only with due solemnity in the inner chamber with one or two intimate companions; to another it is the champagne of life acting as a solvent of all and every care; to a third it is the whisky of modern times, dear and nasty; to yet a fourth, the teetotaller, it is the poison which represents all that is evil. In truth, it is none of these. With what I should like to believe to be the modesty due from one who has in small measure played a part as a research worker, but which may be a penchant for the liquor in question—I would liken it to beer, a very mundane beverage, but one which has done much to lubricate the wheels of existence.

That is true of research in general, and, after all, the question raised by Mr. Hewison is merely one aspect of the question of research in general; the scope of research in its application to the practical activities of man. Research in its application to agriculture is the twin, or, perhaps, younger, brother of what has come to be known as industrial research. How recent is this application of research is in some measure indicated by the remark that as late as the beginning of the century the term industrial research would have been meaningless (article on Industrial Research in the *Encyclopædia Britannica*). It is not surprising, therefore, that the true function and status of research in its general application, and in its application to agriculture in particular, should still remain somewhat obscure. Agricultural research and, in fact, all applied research, has not yet passed that period through which all innovations must pass (through which, for instance, the introduction of steam propulsion in the Navy passed) when it is subjected to a double fire of criticism. On the one hand is the Scylla of scepticism, the denial of utility and the negation of opportunity; on the other the Charybdis of enthusiasm, the claim that a panacea for all economic ills lies therein. Scylla has, perhaps, been safely passed, but the helm may be thrust too far over. There is in all such positions the danger that the pendulum will swing too far. This statement from one whose major interests have been centred in research may appear to savour of heresy, but it is, I think, a true one. This danger that applied research may drift too far from practice has been voiced by others beside Mr. Hewison. It is a real danger which is best met by facing it squarely. It can be met best by a consideration of the wider question of the rôle of research in general as applied to practice. From such a consideration general principles may be traced which can then be applied to the special question of agriculture.

At the outset there arises the difficulty of definition. What is applied research and, for the matter of that, what is research? I offer no final answer to these questions. Merely for the purpose of avoiding ambiguity in what follows I would limit research to the search by scientific method for the fundamental truths underlying natural phenomena. Applied research thus becomes the search for such of these truths as will, it may be anticipated, yield practical results—results, that is, redounding to the physical well-being of man. At a first glance this may appear a sufficiently clear definition, but reflections such as those that follow will soon dispel the illusion.

Two inferences may be drawn from these definitions. In the first place, applied research is merely a branch of general research. Broadly, the distinction is clear, and it is only when an attempt is made to draw a sharp line of demarcation that difficulty arises.

The twigs and the stem are readily distinguished, but who can say at what exact point the stem ceases and the branch begins? A start is made with the breeding of an economic plant, and the work leads imperceptibly through the determination of heritable characters, through linkage to the microscopic structure of the chromosomes. An investigation is made into the quality of steel, and a like series of steps leads to a study of the molecular structure of the component elements. Any attempt to find along these lines the distinctive feature of applied research by which it may be distinguished from pure research is doomed to failure, and any such discussion is as profitless as the endless dialectics of the philosophers of old as to the number of hairs on a bald man's head. A better result will be obtained by following another line of thought.

The second inference is that an economic factor enters into the problem of applied research, a factor which is absent in the case of pure research. With its entry into the economic field, research comes within the purview of finance in a double sense. All research is, of course, subject to financial limitations; that is, the question is not merely whether any particular enquiry is desirable—unless our whole modern outlook on life be mistaken, any extension of our knowledge of the fundamental truths of nature is desirable—but whether among the many calls on available funds, sufficient is available for its prosecution. A relative, and not an absolute, question is raised. But in the case of applied research there is the further limitation implicit in the question whether the available funds, spent in a particular manner, will give an economic return. It is true the return is an indirect one, incapable of being incorporated in the rigid figures of a balance sheet; it is not possible to evaluate at all accurately the contribution of the branch to the stem. That, however, is incidental; it renders a true judgment more difficult, but does not invalidate the principle on which that judgment must be based.

There is, as it appears to me, no getting away from this conclusion. But it is a conclusion which is only too rarely accepted. Nor is this remarkable when, in so many spheres, desirability is considered sufficient justification for a demand for financial support. The fallacy of such an argument has been too clearly exposed by Sir Josiah Stamp ("Christian Ethics as an Economic Factor") to require emphasis here. It is the acceptance of this conclusion, however, which points the way to the answer we seek. If it be inadequate merely to show that applied research is desirable, if a clear financial return according to the tenets of business be impossible, on what basis is the judgment to be made?

Between research in the sense defined—the search after a new truth—and its economic application, there is a gulf which may be wide, and this is so even where the truth laid bare has an obvious economic significance. As between production in the laboratory and in the factory, so between the breeding of a pure strain and its general introduction on a field scale, there arises a series of subsidiary problems. This is not research, no new truth is exposed; it is a testing of ways and means. Nevertheless, it is a gulf that must be bridged, and in this lies the crux of the problem. Towards its solution I would venture the consideration that for research to have an intimate practical objective is not a sufficient contact between it and practice. There is a spirit of enquiry in most investigators which attracts them to the broader and more fundamental aspects, and which, if left uncontrolled, will only widen the gulf. It is a tendency which, under the conditions, requires a corrective, and that corrective is applied by an association of the research proper with the primary stages of economic development. Essentially this means access for the research worker to facilities to try out under economic conditions the product of his research. How far such an extension is possible, and by what actual means it is to be effected, must depend on particular circumstances. At one extreme the necessary liaison will be effected by the association with the research laboratories of a unit of production, probably small, but not too small to be subjected to normal economic tests such as costings. The other extreme arises where the unit of production is too great for such an arrangement to be practical. Here the essential liaison may require the attachment of special trained liaison officers to the industry itself. To discuss this aspect in greater detail would be to pass from a discussion of principle to one of detail.

Evidence comes from more than one quarter of a fear that this liaison at the present time falls short of what is desirable. If I read Mr. Hewison's article aright, it is an expression of this fear in one sphere of activity. There lies, I think, the same fear behind the words of Mr. Kenneth Lee, when he says:

"A closer alliance between science and technology was needed if progress was to be made in mills. Accordingly, the organization committee had agreed to release some of the younger trained staff for service in the industry if any of the members applied for such assistance.

"There was the more necessity for the introduction of a larger number of scientifically trained men in the mills, because it was unlikely that future discoveries could be brought to the point of economic production in the institute, which could only point the way and do laboratory work. Such development must be made under commercial conditions in the mills themselves, and a scientific adviser on the spot would make far more rapid progress than could be achieved by remote control from the institute." (*The Times* report of the annual meeting of the British Cotton Industry Research Association, September 28, 1928.)

Mr. Kenneth Lee is clearly dealing with a case in which the unit of production is large, a case in which it is impossible to attach to the research institution a complete economic unit of production.

I have, so far, dealt with one aspect of the question, the tendency of research to drift towards attacking, and to find satisfaction in solving, the more fundamental problems which are more correctly problems of pure research. The corrective suggested is the association with research of a unit of production capable of being worked on an economic basis. And it may be as well to emphasize here that this does not necessarily imply that the unit will be a profitable venture financially. In fact, this can hardly be so for reasons that any business man will readily appreciate. It does mean, however, that a system of costings will be an essential feature of the working. There is a second aspect which requires to be met, and will be found to be met, most fortunately, by the same provision.

Applied research, I have argued, must justify itself by results, but to whom is it to justify itself? Who are the judges in this matter? The answer is clear in the case of a works research department; it is the directors who provide the funds and who are the judges. It is less clear in the case of a research association based on an industry, for there is not the same facility for recording a definite opinion. It is less clear still in the case of research financed by Government, where the control of funds is vested in an authority which cannot, from personal knowledge, form a judgment. As we pass from defined to undefined control, the opportunity for discord in judgment increases. Unanimity, as has been shown, does not yet exist as to the true value of applied research, and this lack of unanimity is an expression of the conservatism of our producers—a conservatism at which no one will cavil, for it is the outcome of a due appreciation of the risks. Englishmen established their position in industry and in Colonial development by rough-and-ready, but effective, methods, and there is a natural tendency to follow those methods which have proved successful. There is here a lag to be overcome; it is not sufficient merely to take the horse to the water, a certain amount of persuasion is required if he is to drink. I owe to an Indian political friend a full recognition of the fact that it is not sufficient to know that you are right, but you have, by persuasion, to bring other people to the same knowledge. It is as a persuasive factor that the costed out unit will find its second function.

One further word may be permitted on the general question of applied research here discussed. It has been argued that the association with research of an unit of production organized on an economic basis is very desirable, if not essential, if a full return is to be obtained. There is an obvious danger of a too rigid interpretation of these conclusions. The uncertainty of the results attaching to research is notorious, and a comparison is not infrequently drawn between it and a lottery. It is a false analogy. A lottery is unproductive, and involves merely a redistribution of wealth with a certain loss in the process. But if this be true, it is equally true that research has not in it that certainty which forms the basis of a sound industrial business; it does not often realize the value inherent in its own patents. The certainty it does have is that which arises from averaging, the basis of insurance. It follows that judgment cannot be pursued on the result of a single investigation; the institution must be judged by its work as a whole. And where can a better epitome of these results be found than in a working unit of production costed out in the manner outlined above? The second financial limitation now applies to this alone, and freedom is left to those responsible to say how far the work shall penetrate into the realm of pure research.

It is time to leave these generalizations and pass to the more immediate subject of Mr. Hewison's article; to the relation of research to practice in agriculture. In view of what has been already said, the discussion will be brief. We have merely to apply the general principle to the particular case. If agricultural research is not to drift too far away from practice, there must be attached to any institution of which the major function is such research, an estate of a sufficient magnitude to admit of management on business lines. The unit of production is not here of such a magnitude as to render this impossible. Into the general practice of that management will be incorporated the lessons of research, and by its success as an economic unit as distinct from the research itself will the institution be largely judged. The research undertaken may, and no doubt will, include work on problems the solution of which will find no application on the estate itself, for agricultural problems have a habit of being very local. It is not possible to select a site illustrative of every type of soil represented in the sphere of influence of the station, and climate is a purely local phenomenon. Research, too, will require experimental areas as distinct from the estate if it is to have the necessary freedom and facilities. But what is very definitely claimed is that such an estate will give an unity to the work of the institution which it cannot otherwise obtain, and will maintain that true perspective between its work and practice which is so necessary if its *raison d'être* is to be fulfilled.

Such an estate, too, serves the second purpose referred to above: that of persuasion. It provides an object-lesson which answers criticism. And, lest any one should think I am here voicing a theoretical opinion, I would refer to the reports of the Department of Agriculture of the United Provinces, India, from 1921 onwards. At that date intensive criticism was being directed against the Department, and a drastic reorganization of farm policy was effected. Under it a definite demarcation between research, and farm, areas was made, and a complete system of costings applied to the latter. A perusal of later reports indicates a remarkable improvement in efficiency, whatever the standard of judgment employed, while criticism, formerly having the form of an intense demand for closure of farms, now takes the form of an intense demand for opening new ones.

In Mr. Hewison's summary he gives as his fifth conclusion the need for maintaining a correct balance between research and the other activities of agricultural services. The bearing of the above remarks on the point he thus raises is, I think, sufficiently clear. He carries, however, his argument beyond the field of research, and its correct application into the realms of education. His twelfth conclusion is that:

"The training of scientists for agricultural work should include such instruction or experience as will ensure an appreciation on their part of the practical side of the industry and of the economic limitation under which it is carried on."

His criticism here is that the type of education officers of the agricultural departments receive has too great a bias towards research. Here, again, he deals with a particular aspect of a general question and, in that more limited sphere, he is voicing a view which is not without its advocates in the wider sphere. No words of mine are necessary on this subject. The view has, so recently as last autumn, been expressed by Sir Daniel Hall, who writes:

"... Agricultural college training stresses too greatly the scientific aspect of farming as compared with the economic. The student is taught how to improve the soil, how to combine fertilizers for different crops, what seed mixtures to use, how to ration for meat and milk production—essential items of knowledge, but dangerous, perhaps, if not informed by an economic outlook. The maximum crop may be a non-paying one, a dairy herd averaging a thousand gallons may be a dearly bought luxury under suitable conditions. Even the interest the college student is encouraged to take in the types of grass in his pastures is no substitute for the much more necessary watchfulness of the habits of his labourers. Our college education retains too scientific a bent, because those who initiated it forty years ago conceived agriculture as applied chemistry and applied botany, and teachers have found it easier to follow on the formal lines thus laid down than to work out a new course on the basis of personal experience and enquiry.

" The real science of agriculture has not got itself written yet, but it is founded not so much upon chemistry and botany as upon book-keeping. It is a quantitative science, not merely descriptive; it not only explains the various operations necessary to prepare the land for a potato crop, but sums up the horse hours and man hours that should be required at each stage. It leads to a consideration of the probable yields under the variation of soil and cultivation on which to form a judgment as to whether potato-growing will be a profitable branch of business. For farming is a business, not—as the old farmers would have it—an art, seeking the best in the only right way, nor, again, a science which has its own certainty of what is right. Right or wrong in farming is only true in relation to results and prices; what is right on the fenland near Boston may bring disaster on the wolds or the heath but a few miles away. So we need a new kind of teaching that regards farming as the art of management based upon records and accounts, guided by standards of performance and cost whereby to measure the expenditure permissible." (Sir Daniel Hall, review of Farming by E. C. Ash in *The Sunday Times*, October 14, 1928.)

How far the flair towards agriculture lies within the individual, and how far it can be acquired is a matter of personal opinion, and is likely to remain so. For myself I incline to the opinion that, whichever it be, the lack of intimate association with matters agricultural in the early years of life can rarely be made good. Be that as it may, with no limitation of the agricultural services to men who have had the advantage of such early experience, it is essential that the fullest practical training shall form part of the training of men entering these services; and how can this be better achieved than on an estate run on business lines attached to the educational institution? If an estate is essential to an institution whose function is primarily that of research, it is doubly so when that institution also performs an educational function. It is the only manner in which Mr. Hewison's twelfth conclusion can be adequately met.

Many of those who have watched the rapidity with which agricultural research has come to the front in recent years will share the fear, which is really the basis of Mr. Hewison's article, that the pendulum is swinging too far. It would be illogical to argue from that statement that the facilities for research are too great, but it is a recognition of the danger lest the cause of research may suffer, through becoming, by that very speed, too widely divorced from practice. It is a danger which those who share with me a firm belief in the value of research in its application to agriculture must seek to avoid. I have endeavoured, not merely to indicate a means of achieving this object, but to justify my belief in its efficacy by tracing the principles which underlie that belief.

Received October, 1928.

BLACKARM DISEASE OF COTTON

THE DEVELOPMENT OF *PSEUDOMONAS MALVACEARUM* E. F. SMITH, WITHIN THE COTTON PLANT

BY

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I.

SINCE the publication of the paper " On the Relation of Soil Temperature to Angular Leaf Spot of Cotton " by the writer in 1927 (Ref. 4) work has centred mainly on the practical application in the field of the principles evolved from the experiments described therein. Simultaneously laboratory experiments have been carried out in which a greater degree of control over temperature was maintained, the results in both cases being checked by cultural and microscopical examinations. The work, therefore, falls into three parts: (*a*) Microscopical and Cultural; (*b*) Controlled Laboratory Experiments; (*c*) Field Tests.

(*a*) MICROSCOPICAL AND CULTURAL.

1. *Cultural.*—The parasite *Pseudomonas malvacearum* E. F. Smith is a small, rapidly growing, strictly aerobic, highly motile, polar flagellate, non-sporiferous, rod-shaped schizomycete.

The optimum temperature for growth has not yet been determined with exactitude by the writer, but appears to lie about 24° C. The growth rate falls off rapidly above 28°, and ceases above 35° C. The thermal death point varies between 48° and 51° C. On culture media colonies are moist, smooth, shining, with thin regular edges, pale yellow in colour. Abundant slime and a true capsule are produced both in liquid and on solid media. No growth takes place in the absence of nitrogen, and inorganic ammonium salts appear to be less suitable for growth than organic compounds such as asparagin, etc. The reaction of the organism to the principal carbohydrates is shown in Table I.

TABLE I.

A freshly isolated culture of *Ps. malvacearum* was seeded into tubes containing 10 c.c. of the following medium:

KH_2PO_4	1 grm.
$MgSO_4$	0·5 grm.
NaCl	Trace.
Asparagin	5 grms.
Water (tap)	1,000 c.c.

To which were added 5 per cent. of the following:

Carbohydrate, etc.	*Result after Six Days.*	*Slime After Four Weeks.*
1. Starch	0	1
2. Pectin	0	0
3. Mucic acid	0	0
4. Dextrine	2	2
5. Gum arabic	1	0
6. Glucose	4	4
7. Saccharose	3	3
8. Xylose	1	1
9. Maltose	1	1
10. Ammonium oxalate	0	0

0=No growth. 1 to 4=Growth in order of vigour, 4 being highest.

Alkali is formed both in cultures and in the tissues of the cotton plant. As recorded in the earlier paper, the pH range in which growth takes place lies between 5·2 and 9·6 at 20-22° C. The presence of extracellular enzymes was demonstrated by filtering an emulsified culture on potato through a Seitz filter, and adding thin sections of cotton stalk and of potato to the filtrate. Disintegration of the surface layers of the plant tissue took place after seven days' incubation at 22° C. A fragment of thymol was added to the tubes to ensure sterility. It is worth noting that the slime appears to consist largely of pentosan bodies. It is hygroscopic, and probably acts as a protective sheath. Bacteria from slime show mobility at once when a minute portion is added to a drop of distilled water.

Great care must be practised in the isolation of *Ps. malvacearum* E.F.S., as quite commonly the cotton plant is infected with other organisms. Recent work has shown that watery spots on the leaves are caused by at least one organism other than *Ps. malvacearum* E.F.S. These organisms are less sensitive to temperature than *Ps. malvacearum* E.F.S., as will be seen below (pp. 144-5).

It would appear that the Sudan strain of *Ps. malvacearum* E.F.S. is tolerably resistant to sunlight, provided that insulation against the heating effect of the rays is provided. Recently isolated cultures cooled below 35° C. retained their vitality after three hours' exposure to direct sunlight. The resistance to light of organisms taken direct from stem and leaf lesions was tested by emulsifying diseased tissue in distilled water, and exposing a clear drop of suspension to sunlight. Motility was unimpaired by thirty minutes' exposure, but was visibly affected after forty-five minutes, and almost ceased after one hour's exposure. It was difficult to keep the slide below the thermal death point, and it is believed that activity ceased from the effect of heat rather than light. If a broken fragment of tissue were included in the preparation, the bacteria oozing from the tissues were alive after two hours' exposure to sunlight. The identity of the organism was established by inoculation into healthy seedlings.

2. *Histology of the Disease.*—Given heavily infected plants bearing infected bolls, we may safely assume the presence of the bacterium within the placenta at an early stage of the development of the seed. It may be stated at once that the bacterium travels *via* the tissues exterior to the vascular strands, and the spread is never truly vascular. The route mainly adopted is *via* the intercellular spaces of the cortical parenchyma, and in this way the funiculus is quickly crossed and the chalaza reached.

The tissues of this region of the developing seed are reticulate in nature, and present little obstacle to the advancing parasite, with the result that the endosperm is quickly reached, and from this tissue the developing cotyledons are infected by contact. In the case of a heavy infection, lesions are formed on the outermost folds of the cotyledon, which show as blackish spots visible to the naked eye; in other cases the infection is not apparent, and can only be traced with the aid of the microscope. Bacteria remain occluded within the seed coats, so that there is not the slightest possibility of completely disinfecting the ripe seed by surface disinfectants. External infection of the lint is possible through lesions which develop on the boll wall, but this would appear to be relatively rare in the Sudan. The incubation period from the sowing of the seed to the appearance of lesions on the cotyledons varies from ten to twenty-one days, according to the temperature of the soil and air.

The parasite is located in the cotyledon below the epidermis, and spreads laterally through the intercellular spaces, sending down threads of slime between the cells of the palisade parenchyma. The localized accumulation of bacteria and slime leads to the appearance of the familiar water-soaked areas typical of the Angular Leaf Spot stage of the disease, but a cotyledon or leaf may be infected without the development of lesions. The presence of slime, and consequently the degree of infection, may be ascertained by immersing a leaf for thirty minutes in 75 per cent. alcohol tinted royal blue with

Archibald's thionin-methylene blue stain.* Infected areas readily absorb the stain, and contrast vividly with the green of less infected or non-infected areas.

Lesions usually presuppose a varying amount of destruction of the tissues, when the bacteria may invade the vascular region, and permeate the whole of the infected area. The presence of enzymes capable of destroying the middle lamella has been demonstrated, and it is highly probable that a cytase is also excreted, as the parenchymatous tissue is definitely destroyed in the path of the invading parasite, the bacteria first entering the cells from the corner abutting on an intercellular space.

From the cotyledon the organism quickly finds its way through the cortical parenchyma into the corresponding tissue of the first node of the main stem, and as long as climatic conditions remain favourable, each developing organ of the elongating stem is infected in turn. In the stem it has been noticed that for some distance from a lesion the tissues immediately surrounding the vascular bundles—*i.e.*, the endodermis—are destroyed, thus forming a free path for the upward passage of the bacteria; indeed, a stem may be ringed by a belt of actively growing organisms.

In the Sudan the developing ovule is attacked at an early stage as the base of the developing boll is a favourite spot for intensive growth of the parasite, owing to its richness in sugars, and thus the cycle is completed. At the moment of writing the anthers are the only organs of the plant in which the parasite has not been found, though it is very rare to discover them in the root: indeed the few cases reported in an earlier communication need confirmation.

Once the widespread nature of the infection within the host plant is realized, the outbreak of a crop of lesions following rain is easily understood; moreover, it becomes plain how an infected but apparently healthy plant transmits the infection to the seed.

Another point of great importance affecting the progress of the disease, and bound up with its essentially superficial nature, is that external influences may, and do, at any time restrict the growth and localize the parasite: such agents are excessive heat and cold, and the replacement of the thin parenchyma by suberized tissue. The writer believes that the arrest of the disease at Tokar is partly explained by the last mentioned agent. The rigors of the Tokar climate during the early stages of the plant's development will be referred to later. It will be sufficient to add here that, apart from high soil temperatures at germination, the drying, sand-laden winds of the "Habubai" period scorch and desiccate the cortical tissue of the young cotton plants, leading to the early development of cork.

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* See "Practical Bacteriology, Blood Work, Parasitology," p. 60, Stitt, 1927.

Some consideration may now be given to the natural location of the parasite in relation to its requirements for growth. Microchemical tests and staining reactions show that, in the leaf, pentosans are present in the middle lamella, in the outer sheath of the sieve tubes, and in the guard cells of the stomata. Reducing sugars and sucrose are abundant in the leaf, the cortical parenchyma, and in the phloem.

The recent researches of Mason and Maskell on the transport of carbohydrates in the cotton plant are most illuminating, and explain the path taken by the parasite (Ref. 3). They state: "In the chlorophyll tissue the reducing sugars constitute the greater part of the sugars, and are consequently present here in higher concentration than in the sieve tubes, where they form only a small part of the total sugars. In consequence, reducing sugars move along a concentration gradient from the chlorophyll tissue into the sieve tubes, and are there synthesized to sucrose. The leaf cells are relatively impermeable to sucrose, so that there is no appreciable leakage of sucrose back into the leaf parenchyma. A considerable head of sugar, mainly sucrose, is thus generated in the sieve tubes of the leaf."

They found that "(1) Sucrose was present in higher concentration in the midrib than in the lamina of the leaf, and (2) the concentration of reducing sugars in the leaf lamina was greater than in the sieve tubes of the leaf, and consequently was greater also than in the sieve tubes of the bark.

"The sieve tubes of the midrib are surrounded by a tissue having on the average a higher concentration of reducing sugars than the leaf parenchyma.

"In the stem, the bulk of the sugar is located in the bark, and the concentrations in the three fractions of this tissue are of interest.

TABLE II.*—SUGAR CONCENTRATIONS IN THREE FRACTIONS OF BARK.

Per Cent. Sugar.	*Outer Fraction.*	*Middle Fraction.*	*Inner Fraction.*
Sucrose	1·425	1·850	2·498
Reducing-sugars	2·205	1·605	1·237
Total sugars	3·630	3·455	3·735

* Mason and Maskell, p. 601.

"In the boll reducing sugars again predominate, sucrose being present 0·626 per cent., and reducing sugars 4·870 per cent. Sugars are manufactured in the leaf tissue, being at their maximum concentration in the afternoon, and at a minimum during the night. Changes in sugar concentration of the leaf sap are followed in a few hours by similar changes in the bark sap, the route of transport being through the sieve tubes. It is not known with certainty which sugar is first formed in the leaf, but transport within the sieve tubes takes place in the form of sucrose."

We see, therefore, that localization of the parasite takes place in accordance with the food supply, and in this connection it is interesting to note that heavily infected seed germinated and kept in darkness produced seedlings showing no trace of infection after twelve days, but lesions appeared in due course when photosynthesis began after exposure to light. Also, lesions were not formed when seedlings were exposed continuously to the light of a 60-watt electric lamp. The reason for this is not immediately clear, but the lack of development of the parasite in the darkened plants suggests starvation.

(*b*) Laboratory Experiments.

As indicated in the opening paragraph of this paper, the aim of the laboratory experiments was to determine with greater exactitude the effect of temperature on the development of the parasite within the germinating seed and the resulting seedling. In addition, plants were grown to maturity in soil maintained at varying temperatures.

The seed used throughout all the work was obtained from heavily infected parents, and no appreciable resting period existed between the picking of the seed and sowing. It was thought that by this means the parasite would be obtained at the maximum degree of virulence, as storage of infected seed unquestionably affects the vigour of the resting organism. Indeed, at the commencement of the experiments, 1,000 Ashmouni seeds from the supply used in earlier work, which had been in storage in the laboratory for three years, produced at the most 5 per cent. of infected seedlings. Also, in the case of a Sakel seed two years old, the amount of infection, as judged by the production of infected seedlings, fell from 96 per cent. to 31 per cent. after two years' storage.*

The work described below was carried out in two houses erected at a short distance from the main laboratory, and styled Pathological Houses (Nos. 1 and 2). No. 1 House was used for experiments requiring low temperatures, and consisted of four thick mud walls roofed with a pent roof consisting of thin white calico. No. 2 House was adjacent, and was employed when high air and soil temperatures were required. The floor of this house was sunk to a depth of 1½ metres below ground level, and the roof consisted of a lean-to framework covered with Windolite, facing due east.

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* See also Ref. 1.

The experiments fall into four groups. In the first the plants were grown in 4-inch earthenware pots immersed in sand, the temperature of which was controlled by means of electric lamps. In the second, tins were employed of such a size that plants could be grown to maturity. Thirdly, plants were grown within an enclosed space in an atmosphere saturated with moisture; and lastly, miscellaneous treatments were tried as suggested by contemporary experiments.

No attempt was made to control humidity in the first two groups, and, as the humidity was never high, the lesions were almost entirely confined to the stem. The humidity in Group II. was definitely higher than in Group I. [In Group II. the temperature of the soil was maintained near 30° C. by means of specially constructed boxes, consisting of an outer wooden box containing an inner zinc tank holding water warmed by two electric bulbs, placed beneath, and controlled by Hearson's thermostats. Within the zinc tanks were the tins in which was the soil and the growing plant. The whole device was cheap and efficient.

EXPERIMENTAL DATA: GROUP I.

Soil temperature controlled. Humidity uncontrolled.

SUBGROUP A.—Seedlings raised in soil the temperature of which varied between 18·5° and 20·7° C.

Experiment 1.—Treatment as above. At the time of the first examination, twelve days after sowing, very little infection was visible. At the conclusion of the experiment, some two months after sowing, 12½ per cent. of the plants showed slight lesions at the first node. No leaf infection was obtained.

Experiment 2.—One month after sowing seedlings from Subgroup A were moved to beds, the temperature of which was maintained at 25° to 27·9° C. After fifteen days the amount of infection as measured by recognizable stem lesions had risen to 47·3 per cent. In a few cases the lesions developed to such an extent that growth of the plants was arrested.

Experiment 3.—Simultaneously with Experiment 2, a further batch of seedlings one month old from Subgroup A was removed to a bed in House No. 2, the temperature of which was maintained between 29·5° and 31·7° C. Fifteen days afterwards 23·2 per cent. of the plants showed small stem lesions, which, however, never became sufficiently serious to hinder the growth of the plants, and eventually dried.

Subgroup B.—Seedlings raised in pots immersed in sand, the temperature of which varied between 25° and 27·9° C.

Experiment 4.—Treatment as above. Twelve days after sowing the amount of infection was 24·4 per cent. The lesions in this experiment were more pronounced than in any experiment of Group I.

Experiment 5.—On account of the serious nature of the lesions, plants from Subgroup B were moved to the hot bed in House 2 at an earlier stage—*i.e.*, seventeen days after sowing. The temperature of this hot bed was maintained between 29·9° and 32·9° C. Fifteen days after sowing the amount of active infection had decreased to 7 per cent., the remaining 17·4 per cent. (see Experiment 4) having dried up.

Subgroup C.—Seedlings raised in pots, the temperature of which was maintained between 28·1° and 33·1° C. in Pathological House No. 2.

Experiment 6.—Treatment as above. Twelve days after sowing the plants were examined. Lesions were small and difficult to determine, but, by counting every suspect, the amount of stem lesions obtained in this bed was 8·2 per cent. These dried after a further seven days, and a month after sowing the plants presented a healthy appearance.

Experiment 7.—Seventeen days after sowing plants of this Subgroup C were removed to the intermediate bed—*i.e.*, the soil temperature was decreased to 25-27° C. Fresh infection developed, and the maximum amount recorded at the conclusion of the experiment was 23·4 per cent.

The experiments described above confirm the conclusions arrived at in the earlier paper, and emphasize the fact that the germinating seed must be maintained above 30° C. before even apparent immunity is obtained.

Group II.

In this group of experiments the plants were raised in tins sufficiently large to enable fruiting to take place.

The individual treatment will be described under the different headings.

Experiment 8.—Seedlings were raised in tins which were immersed in water contained in a porous brick trough. The temperature of sowing was thereby maintained between 15° and 22° C.

One month after sowing 21·6 per cent. of the seedlings showed small lesions at the first node, when the tins were removed to the Pathological House No. 2, and the soil temperature maintained between 31·6° and 33° C. The humidity was markedly higher (see Fig. 3 at end) within the house, with the result that the lesions at first increased, but subsequently, as the plants developed, dried out.

A few bolls were obtained and the seed sown, with the result that 5 per cent. of the seedlings showed slight sign of infection. It will be remembered that the parent seed was heavily infected.

Experiment 9.—In this experiment seedlings were raised in tins, the soil temperature of which fluctuated between 29·6° and 32·2° C. An initial infection of 16 per cent. was obtained, but the plants quickly outgrew the infection, and after a month appeared healthy.

Seed was obtained in due course, which was also infected to the extent of 3 per cent.

Experiment 10.—Rather more variable treatment was given in this experiment. Seeds were sown in soils maintained at 30° C. for three days, after which water at a temperature of 20° C. was added, and the tins maintained at 26° C. for a week. A light infection was thereby induced in the seedlings. The soil temperature was then raised to 30° C. and maintained between 29·5° and 32° C. until the conclusion of the experiment. Lesions appeared at the first node, but the plants speedily recovered.

Mature plants bearing bolls were obtained, the seed of which subsequently showed an infection of 12 per cent.

GROUP III.

In the preceding experiments no attempt was made to estimate the effect of humidity on the development of the disease, as the object of the work was to demonstrate the influence of soil temperature on the infected seed during the period of germination. The figures for the daily evaporation as recorded by Piche Evaporimeters suspended in the Pathological House No. 2, and in the Farm screen, are given in Figs. 2 and 3, from which it will be seen that the average humidity within House No. 2 was reasonably comparable with the averages given for the Gezira for the months of August and September. As closer control of the Pathological House No. 2 was impossible, seedlings were raised within a Hearson germinator.

Experiment 11.—Seedlings raised in pots within a Hearson germinator, and the soil temperature maintained between 29·9° and 33° C. The enclosed air was saturated with moisture throughout the whole experiment. What follows is remarkable, and furnishes a most valuable clue to the behaviour of the infected seedlings under field conditions in the Gezira during the critical months of July and August.

No lesions developed until after thirteen days, by which time the seedlings had reached the glass cover, the temperature of which was cooled down at night to between 18·6° and 20° C.

Heavy condensation of water took place each night on the cooled surface, and thus the cotyledons were not only cooled, but bathed in condensed water. Lesions rapidly appeared, and between the fourteenth and twentieth day the number of the seedlings showing marked infection reached 57·6 per cent. of the whole. The characters of the lesions made it evident that infection was taking place from plant to plant through the film of water on the glass cover of the germinator (see below, pp. 140-1).

Experiment 12.—The last experiment opened up a new field of thought, and the experiment was repeated, but two types of soil were employed, one a light sandy loam and the other a heavy clay soil from the Gezira.

Precisely the same effect was obtained, and no significant difference in the amount of infection was recorded, the ultimate percentage being 57·1 per cent. in the Gezira soil and 57·8 per cent. in the light loam.

The electrical supply failed shortly afterwards, and this promising line of attack was necessarily abandoned, but it is now being re-investigated.

Experiment 13.—There was always the possibility that apart from the temperature effect the increased infection in Experiments 11 and 12 might be due to the waterlogging of the tissues by the film of condensed water formed when the leaves touched the glass. Accordingly, a fresh experiment was planned. Eight pots, each containing both visibly infected seedlings and apparently healthy ones, were enclosed in a cupboard having glass sides. In four pots the cotyledons and the pair of leaves at the second node were smeared with vaseline in order to close up the stomatal slits. The remaining four pots were left as controls. The eight pots were placed in a shallow trough containing about 1 inch of water, and the soil temperature maintained between 29° and 33° C. by means of an electric lamp which was extinguished late at night.

The humidity within the cupboard varied between 40 per cent. and 80 per cent. Visible waterlogging of the tissues of the vaselined series occurred after five days, and the infected plants showed definite distress. On the tenth day plants of the vaselined series which previously had exhibited slight lesions were heavily infected, and on the eleventh, when microscopical examinations were made, the upper pair of leaves was also infected, and showed large patches of water-soaked tissue. In the case of the control series, the effect of increased temperature and humidity was simply to promote extra growth, and even the small lesions existing previous to the experiment disappeared.

GROUP IV.

In all the previous experiments the soil temperature had been partly controlled. Entire control was not feasible, as this would have necessitated a large cooling plant to cope with the heat of midday. Also the plants were raised within an enclosed area, whereby partial shade was unavoidable.

In the experiments about to be described the plants were raised out-of-doors in the open air, the amount of shade provided being indicated under each individual heading.

Experiment 14.—Two batches of seed, sown in pots, were germinated under similar conditions, the soil temperature being 28° C. After six days they were removed into the wind and full sunshine, and one batch carefully watered by hand so that the foliage was not touched, while the other batch was watered from above with water at 20° C. The soil temperature ranged from 15·7° to 26° C. Fifteen days after sowing the seedlings were examined with the following results:

Series (*a*) Soil only watered—infection 21 per cent.
„ (*b*) Foliage watered—infection 50·5 per cent.

Experiment 15.—Seed was sown in a rectangular porous brick tank with double walls, the inner wall being perforated at the base to admit water freely. Water was poured into the outer shell to maintain the soil in the tank at a moisture content sufficient for germination and growth.

Light shade from the midday sun was afforded by a horizontal screen placed 6 feet immediately above the bed, otherwise the tank was unsheltered. The temperature of the soil ranged between 10° and 20° C., and fifteen days after sowing the number of plants was appreciably lessened by *Rhizoctonia* Wilt. No bacterial lesions whatever were seen up to the conclusion of the experiment, eleven weeks after sowing.

Experiment 16.—The effect of waterlogging the soil was studied by growing plants in large tins placed in water contained in brick tanks. Half of the tins were perforated at the base and half unperforated. The height of the water was halfway up the tin.

The results were unexpected, and need investigation; the only clue that can be afforded at the moment is that the waterlogged plants were stunted and woody in nature.

Series (*a*) Perforated tins:
Soil temperature, 15·5° to 22° C.; infection, 0·3 per cent.
„ (*b*) Perforated tins:
Infection, 3·1 per cent.
„ (*c*) Unperforated tins:
Soil temperature, 14·2° to 25·7° C.; infection, 20·0 per cent.

Soil and air temperatures were low, and evaporation high (see meteorological data in Figs. 1 and 2), which lends further weight to the view now held that it is the combination of all three factors which determines the intensity of the infection obtained in plants grown from seeds carrying *Ps. malvacearum* E.F.S.

(*c*) FIELD EXPERIMENTS.

In the previous paper evidence was brought forward establishing a definite correlation between the incidence of rainfall and the degree of infection obtained in the field. During the following season an experiment was planned whereby sowing dates were regulated by the rainfall during July, August, and September, 1927. The details of this experiment are given in Fig. 4, which depicts graphically the main environmental factors during the experiment. It only remains to add that the individual plots were 180 square metres in size, and that each sowing date was repeated six times, the plots being arranged at random.

The degree of infection existing within the plots is reflected in the yields of seed cotton obtained.

	Yield per Feddan (Rotls).
First date of sowing July 1, 1927	681·5
Second „ „ July 21, 1927	877·0
Third „ „ August 15, 1927	942·0
Fourth „ „ September 21, 1927	354·0

The September 21 plots were severely attacked by Pink Bollworm in March, so much so that the experiment was abandoned, the plants being cut out and burnt in an effort to control the pest.

The yield recorded therefore in this case bears no relation to the potential yield, had this damage not occurred. It must therefore be emphasized all the more that only a few plants exhibiting typical watery lesions were found following the rainfall on September 26, and that these were pulled out early in October. Otherwise the September plots appeared free from infection throughout.

The pickings were divided into three portions—*i.e.*, those from the topmost bolls of the picking, those from the middle, and those from the lowermost bolls. It does not, of course, follow that the topmost bolls are from the top of the plant. The idea was to follow the course of the infection throughout the plant.

The percentage of infection, as measured by the number of infected seedlings developing from the samples of seed, is interesting.

TABLE II.

Bed.		*Picking Number.*	*Position of Seeds.*	*House Number.*	*Date of Trial.*	*Soil Temperature.* (8 *a.m.*)	(2 *p.m.*)	*Infection Percentage.*
						Degrees C.	Degrees C	
First sowing July 1	A	Third	Bottom	2	25/2/28	18·8	31·4	20·6
	A	Third	Top	2	25/2/28	18·8	31·4	11·3
	A	Sixth	Bottom	2	25/2/28	18·8	31·4	31·9
	A	Sixth	Top	2	25/2/28	18·8	31·4	16·0
Second sowing July 21	B	First	Bottom	2	25/2/28	18·8	31·4	21·6
	B	First	Top*	2	25/2/28	18·8	31·4	10·1
	B	Fourth	Bottom	2	25/2/28	18·8	31·4	18·1
	B	Fourth	Top	2	25/2/28	18·8	31·4	8·8
Third sowing Aug. 15	C	First	Bottom	2	25/2/28	18·8	31·4	34·0
	C	First	Top*	2	25/2/28	18·8	31·4	18·9
Fourth sowing Sept. 21	D	First	Bottom	2	25/2/28	18·8	31·4	5·6
	D	First	Top*	2	25/2/28	18·8	31·4	3·5
	D	Second	Bottom	1	13/3/28	21·5	29·7	Nil
	D	Second	Top	1	13/3/28	21·5	29·7	Nil
	D	Third	Bottom	1	13/3/28	21·5	29·7	Nil
	D	Third	Top	1	13/3/28	21·5	29·7	Nil

* *I.e.*, top of first picking, not necessarily top of plant.

The accuracy of the September figures has been checked by sowing at the Gezira Research Farm this season. The Duty of Water Plot sown with the seed from this plot (second and third picking) was examined personally during August, September, and October, and only traces of disease found. Time did not permit of a count. This has been confirmed during November by Mr. Lambert. The striking nature of this experiment cannot, however, be depicted by means of figures. The plants sown during July were literally rotten with disease, whilst the September sown cotton was most luxuriant in growth. Only a photograph can portray the degree of control obtained.*

The success of the above experiment suggested that cotton might be grown for seed purposes at a time when the prevailing high temperatures normally preclude the possibility of obtaining a commercially successful crop, and it is interesting to observe that this was one of the measures recommended for control purposes by the writer in 1923. Accordingly seeds of an improved strain were sown in February and March this year (1928). A fortunate change of weather at the end of February made it possible to sow half the area at the lower end of the temperature scale over which experimental work on this disease has been conducted—*i.e.*, 14° to 25° C.

Later on in March the temperature again rose, and the remaining half was sown in soil the temperature of which ranged between 25° and 40° C. Details of the maximum soil temperatures are given in Fig. 5. A careful watch was kept for the appearance of bacterial lesions, but none were found, and the crop remained healthy until October† when it became desirable to uproot to prevent the spread of insect pests to the new crop near by. It is worth noting that the crop remained comparatively free from insect pests until September, when a few stainer bugs and bollworms (red and spiny) made their appearance.

In all, 618 rotls of seed cotton were obtained from this one feddan plot, and up to the time of writing all seedlings raised at Shambat from the seed have proved to be free from disease. A careful bacteriological test has, however, yet to be concluded.

It was suggested by Major Archibald that seed from this plot might be sown at Tokar in September, thus providing an increased supply of fresh seed for sowing during the season 1929-30. This plan would have the additional advantage that Tokar grown seed is noted for its extra vigour and comparative freedom from disease.

Accordingly seed was taken by the writer and sown in Tokar Seed Farm on September 12, 1928.

The soil temperatures were running very high at this time, being

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* See "Agricultural Research Work in the Sudan," p. 142, 1928, issued by the Empire Cotton Growing Corporation.

† See, however, later, p. 140.

85° to 38° C. at 9 a.m., and naturally no sign of disease could be found in any of the earlier sown young seedlings near by. Moreover, a microscopical examination failed to detect any trace of the parasite in seedlings gathered from various sites on the Seed Farm. The same applies to other parts of the delta, and the writer believes that, while a little dormant infection is possible at Tokar when infected seed is sown, the climatic factors of Tokar are, generally speaking, the greatest natural aid we possess for the production of germ-free sowing seed.

The next step was to apply experience gained in the season 1926-27 to the Gezira during the present season. Two factors were involved—namely, the temperature of the soil and the incidence of the rainfall. It has been explained that these factors are closely linked during the usual sowing period, therefore measures were considered whereby the cooling effect of rainfall might be minimized. In the first place, the normal peak of the rainfall curve occurs about August 10, and therefore it was advisable to delay sowing until after that date (see Fig. 8). Secondly, provided that the irrigation water was applied during July, it was feasible that no water would be required during August, and waterlogging of the soil due to rainfall plus irrigation would be avoided; moreover, the cooling effect of rainfall on moist warm soil is less than on dry soil, when the surface layers only are considered, and therefore it was arranged to water the soil during July and to allow it to partially dry and to store up heat before sowing.

Two self-recording thermometers were erected on representative plots near rain gauges, the records from which are summarized in Figs. 6 and 7.

Considering the plots in order of sowing, the Ganabia 40 area was watered by irrigation during July, the water being cut off on July 31. Sowing took place on August 10, and no more irrigation water was applied until September 6. Reference to the figures shows that rain occurred at frequent intervals during August, and particular stress must be laid on the rainfall immediately following sowing.

From the data already given in this paper it will be understood that visible infection of the growing seedlings was inevitable. Fortunately a hot, dry September has checked the development of the disease, but it is certain that this plot will carry the parasite until the end of the season.

The Wad el Niam 3 plot was not sown until August 25, irrigation having ceased on the 20th. A little rain (4 mm.) fell on the 28th, but there was no more rain until September 12, when again only 4 mm. was recorded. The soil temperatures ran consistently higher than in the case of the Ganabia plot, with the result that when an inspection was made on October 12 and 13 no trace of disease could be seen on the growing plants. Moreover, no parasites could be detected either culturally or microscopically in the tissues of the plant samples. Later examination in January has confirmed these findings.

Now it will be immediately argued that rainfall is uncontrollable, but an effective counter to this is found in this year's figures for temperature and rainfall. Rainfall in the Gezira plain is notoriously capricious and localized, and averages are not yet available. The average rainfall for Medani during August is officially given as 148 mm., for Tayiba it is 134 mm. For the Gezira Research Farm it is somewhat higher (about 170 mm.). Now 173 mm. fell near the Wad el Niam rain plot (it may be safely asserted that in the central area rains were heavy this year during August), and yet the soil temperatures were fairly high. The physical character of the soil at Wad el Niam is not markedly different from the Ganabia area; wherein lies the secret ?

The writer believes that by carefully watering the soil during July and the first half of August, and by allowing it to absorb heat, the cooling effect of rain can be largely nullified, and that even with normally infected seed the disease can be controlled to such an extent that it will no longer become a serious menace. Complete control by cultural methods over such a large area is probably impossible

Yet another point must be emphasized: a high degree of moisture in the surface layers of the soil—*i.e*, the layers in which the seed is sown—is not necessary for successful germination;* indeed, from the present point of view it is extremely harmful. Seed germinates at Tokar in soil which is just moist, and provided that there is moist, not wet, soil below, the seedling will obtain its requirements, and develop a vigorous root system all the better if irrigation is limited during the early stages of growth. A wet soil is a cold soil, a moist soil can be made to store up large quantities of heat. Further, light rain, such as may be normally expected once the peak of the curve is passed, penetrates very little, so that if the seed is sown in a hollow, such as is made by the careful cultivator with his Seluka stick, the chances of maintaining a warm germinating bed are greatly increased, with consequent control of infection.

Examples of successful sowing in what appears to be excessively dry soil occurred in Darwish area this year, and a very striking demonstration of what can be done by deep sowing in moist, not wet, soil was made by Mr. A. R. Lambert on the observation plot of the

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* 20 to 25 per cent. will ensure germination.

Gezira Research Farm during August. Not only was his germination excellent, but the resulting plants were remarkably healthy in appearance. Within certain limits, a small water content of the soil stimulates the roots to greater development, so that they are better able to withstand drought at a later stage. The plant is plastic and adapts itself to its environment. The character of the whole plant can be moulded, within limits. Even the number of stomata formed are regulated by the environment during development.

Another important aspect of the disease is the possibility of its spread in the field from one plant to another. Now, while insects might conceivably act as intermediates, the writer believes that the available evidence does not support this view. Definite plant to plant infection can take place through contact, but rapid spread of the disease is always associated with rainfall, and this year definite evidence of the influence of rainfall was obtained at Shambat in the March sown plot.

This plot remained free from visible infection until October. At that time there was growing on the north and west sides infected cotton which had been sown in July, bearing moist lesions. Fourteen days after a rainstorm accompanied by high wind, lesions were found on the leaves of the outside adult plants of the March sown plot on the north side. None were found in the body of the plot, nor were any found along the west border. By the end of the rains (*i.e.*, October 9), which were light this year at Shambat, the infection had penetrated 180 cm. into the northern strip of the plot—*i.e.*, a depth of four plants.

Now at Shambat the rainstorms are cyclonic in character and strike mainly from the north-east; they are also usually accompanied by strong winds. Careful examination of leaves bearing lesions has shown that there is a thin layer of slime containing viable bacteria on the epidermis, and it has been proved by actual observation that the stomata within the area of a lesion distend greatly on application of water owing to increased internal pressure, and that bacteria exude from the enlarged pore in immense numbers. The resistance of the organism to sunlight has been discussed in Part I. of this paper.

A recent experiment carried out in the writer's laboratory in conjunction with Dr. Gregory has shown that the parasite moves rapidly in thin films of water, so that there would be no difficulty in the bacterium infecting the plant via the stomata in a very short space of time. The writer has shown in the previous paper that this does occur, and has emphasized that special environmental conditions are necessary for successful infection. The requisite conditions are a high degree of humidity, thus causing the stomata to open, a thin film of water on the surface of the leaf, and, lastly, a suitable air temperature. Unfortunately all these conditions are present in the Gezira during the rains, and, given a certain amount of infection, it is not necessary to postulate any other carrier to explain the rapid spread of the parasite at this period.

II.

We have now reviewed the factors leading to the inception of the disease in the young seedlings, and mention has been made of the location of the parasite within the tissues, and its method of spread, both within the host and to adjacent plants.

The following points must now be briefly considered: (*a*) varietal resistance and the distribution of the disease within the Sudan, and (*b*) the factors controlling the progress of the disease in the growing plant once the parasite has gained an entrance into the main stem.

(*a*) American Upland cotton, as grown in the northern Sudan, Khartoum district, and in the Nuba Mountains district, is normally not badly affected by the disease; but of course the degree of infection varies from year to year, according to climatic conditions. In Mongalla there are districts which suffer heavily, but again on elevated land the disease is not serious. Pima cotton and Ashmouni varieties appear to be very susceptible, wherever grown, but Sakel varies in its resistance according to the locality. In the Gezira the disease is a constant menace; at Kassala initial infection followed by recovery is the rule; but at Tokar little or no infection is ever found. No cotton has yet been found in the Sudan which is entirely resistant.

(*b*) The importance of rainfall during the period of germination has been emphasized. We have now to consider its influence on the infected plant at later stages of growth in the light of experience gained from Experiments 11, 12, 13, and 14. Experiment 13 has shown us that, when stomatal action is checked, heavy infection ensues. Can this be correlated with the effect of rainfall on transpiration? Now while stomatal movements are as variable as the weather, it may be taken for granted that, normally, stomata open after daybreak. Should the weather be fine and sunny, closure does not take place until forenoon, always provided that the water content of the soil is sufficient for the plant's requirements. By noon the stomata are closed, and their subsequent behaviour until dark depends on such factors as water content of the leaf, and the state of the sky; but in any case complete closure occurs at sunset. The moisture in the leaf reaches a maximum about dawn, rising steadily during the night. It then falls rapidly until the afternoon, and remains at a steady low level until late afternoon.

What follows is taken verbatim from "The Behaviour of Stomata," by J. V. G. Loftfield, pp. 74-75 (Ref. 2).

"6. When the temperature of the soil rises too much, the stomata close, and in extreme cases the plant wilts.

"7. The temperature of the leaves was usually found to be lower than that of the air when the stomata were open, and higher when closed in sunlight.

"10. When the leaves of a plant were wet by dew or rain, or wet artificially, the stomata usually opened if closed, or opened more widely if partially open. When the water dried, the stomata closed wholly or partially.

"13. Water content of the soil is the chief of the factors that determine the rate at which the leaves can be supplied with water. When the soil is dry, the rate of supply is slow, causing turgor to be lost early in the day, and the stomata to close.

"15. The maximum of leaf turgor in most cases is reached about midnight. After stomatal opening at daybreak, or shortly afterwards, it begins to decrease, the rate being dependent upon transpiration on the one hand and water supply on the other.

"Part of the water present in the leaf at the start is a working margin, and the stomata do not close until this is gone. If the roots can keep up a sufficient rate of supply, this working margin does not wholly disappear during the day, and the stomatal movement is of the normal light-induced type. If the margin is lost, however, the stomata close until it is recovered at least in part.

"16. The nightly maximum of leaf turgor increases after every rain or irrigation, and thereafter decreases until the next rain. Such fluctuation between rains is often very great. In lesser degree the critical leaf water or percentage at which the working margin disappears also fluctuates between rains or irrigations.

"20. The number and size of the stomata on any given area of leaf are influenced by the conditions under which they were formed. A leaf developed in the shade has fewer and larger stomata per unit area than are produced in sunlight."

The physiology of the young cotton plant during the rainy season may therefore be pictured as follows:

In the evening the plant is busy replenishing its store of water, stomata are closed, and absorption by the root rapid. Should rain occur, the relative humidity rises and the aerial portions of the plant are also rapidly cooled. Only the surface layers of the soil will, however, be affected, and we may assume that root action will not cease at once, with the result that tissues tend to become turgid with water, a condition eminently suited to rapid growth of the parasite. Rain during the day will promote the spread of the infection, not only externally from plant to plant via the opened stomata, but also internally by inducing a water-soaked condition of the tissues.

It must be remembered that the cotton plant is growing at maximum speed during the days following germination, and that the physiological processes underlying water absorption by the root and transpiration by the leaves are very delicately balanced. Sudden disturbances such as are caused by alteration of temperature and humidity cannot be adjusted immediately, with the result that the parasite gains ground at the expense of its host. The curves depicting the relevant meteorological data for the three main cotton-growing centres of the Sudan are included at the end of this paper (Figs. 9 to 12). They are taken from Bulletin 47 of the Ministry of Agriculture, Egypt, entitled, "Cotton Growing in Relation to Climate in Egypt and the Sudan," by C. B. Williams.

It is necessary to remark that, since the information regarding Sudan conditions was given to Mr. Williams by the present writer, agricultural practice in this country has been somewhat modified; in particular the sowing date in the Gezira has tended to become later. A study of the curves given in Figs. 9 to 12, and in this bulletin will, in the light of our present knowledge, explain the relative degree of infection experienced in Tokar, Kassala, and the Gezira.

III.

We must now consider the question of the control of the disease in the field. It will be obvious that it is impossible to disinfect the seed by means of chemical disinfectants, for the parasite is too deeply located within the tissues of the resting seed. Similarly, a stimulation of the growth processes can in itself only lead to the non-visible type of infection, since the plant has no real powers of resistance. We have seen that an outwardly healthy plant can transmit infection by the seed. It would appear, however, that we can inhibit the inception of the disease at the time of germination by manipulation of the seed bed, whereby water is stored below, but the upper layers are maintained warm and just sufficiently moist to promote germination. Complete control, however, by such methods is wellnigh impossible over a large area, and we must look to other methods for the hope of eradication of the parasite.

In the writer's opinion, the only agency which offers a fair chance of success is dry heat, possibly coupled with storage. Experiments were begun during the 1926-27 season, but pressure of work forbade a thorough investigation of the possibilities of this method. A freshly collected highly infected seed was used, and by raising the temperature to 95° C. for five hours the amount of infection was greatly reduced. More recent work has shown that a lower temperature applied over a greater period of time is more efficient, and has the advantage that germination is not adversely affected; indeed, preliminary work suggests that it is stimulated. Infected seed heated at 85° C. for forty-eight and seventy-two hours has maintained its vitality unimpaired, and has produced seedlings which show no lesions whatever. There has not yet been time to examine such seed culturally.

Heated seed has been sent to the Gezira and to Tokar.

In the Gezira sowing took place on September 21 and 22. Germination was normal, and the plants, though backward through late sowing, are healthy. A few doubtful lesions are reported to have appeared on marginal plants where the plot adjoins earlier infected cottons, but Mr. Craig has seen no other signs of infection.*

At Tokar one does not expect to find visible infection, and no verdict can be passed until the crop is harvested, when the seed will be examined culturally. It must be mentioned at this stage that watery lesions caused by an organism other than *Ps. malvacearum* E.F.S. may appear on heated seed, if germination is carried out at a low temperature. The matter is under investigation, so that only one result will be now described.

A batch of heated seed was sown in both Pathological Houses. In No. 1 the temperatures varied between 14° and 23° C., and after fourteen days 14·3 per cent. of the seedlings showed watery spots along the edges of the cotyledons. A similar batch of seed was sown in House No. 2, where the soil temperature ranged from 19° to 28·7° C. No infection of any description was seen. When the spots from House No. 1 were examined culturally, an organism resembling *Ps. malvacearum* E.F.S. was isolated, but inoculations into the stem failed to produce lesions; moreover, the lesions on the cotyledons quickly died away.

The colonies of this organism are of a different shade of yellow, and in other characteristics the bacterium departs from the typical *Ps. malvacearum* E.F.S.

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* Kindly reported by Mr. H. E. King.

Other than those made in the text, the writer wishes to acknowledge the assistance received from Mr. H. Poyntz Wright, Manager of the Sudan Plantations Syndicate, Mr. Lloyd Warren, also of the Sudan Plantations Syndicate, and Mr. M. A. Bailey, Government Plant Breeder.

He also wishes to record his appreciation of the work of his assistants Hassan Eff. Shehata Hassan and Sayed Eff. Ahmed Abdulla, and more recently Mr. M. C. Hattersley.

To Dr. E. J. Butler, F.R.S., he is indebted for much kindness in the past, and for help which will bear fruit in future work.

SUMMARY.

1. The habits of the parasite *Ps. malvacearum* E. F. Smith, its requirements for growth, and location within the cotton plant have been described.

2. The influence of environmental factors on the progress of the disease has been considered, and it is explained how it is possible for an apparently healthy plant to be actively infected and to transmit infected seed.

3. The effect of soil temperature on the development of the disease has been studied and earlier work confirmed.

4. But it is pointed out that the immunity obtained at 30° C. may be apparent only.

5. Definite immunity cannot be obtained under 32° C., so that the action of temperature at the time of germination may be a straightforward one, and not complicated by other factors.

6. The value of dry land farming and the effect of sowing in the field at different periods of the year are explained.

7. The spread of the disease to adjacent areas following or during rainfall accompanied by wind has been described, and the opinion expressed that this natural means of conveyance, coupled with the stimulation of the parasite already in the tissues by favourable environmental conditions, is sufficient to explain the familiar phenomenon of a sudden outbreak of lesions some twelve days after a rainstorm.

8. The effect of induced waterlogging of infected tissues has been described, and the possible effect of rainfall in this connection has been discussed.

9. The relevant conditions obtaining at the three main cotton-producing centres of the Sudan have been briefly noted, and the value of Tokar as a propagation area for clean seed has been emphasized.

10. The effect of storage and of dry heat on infected seed has been commented on.

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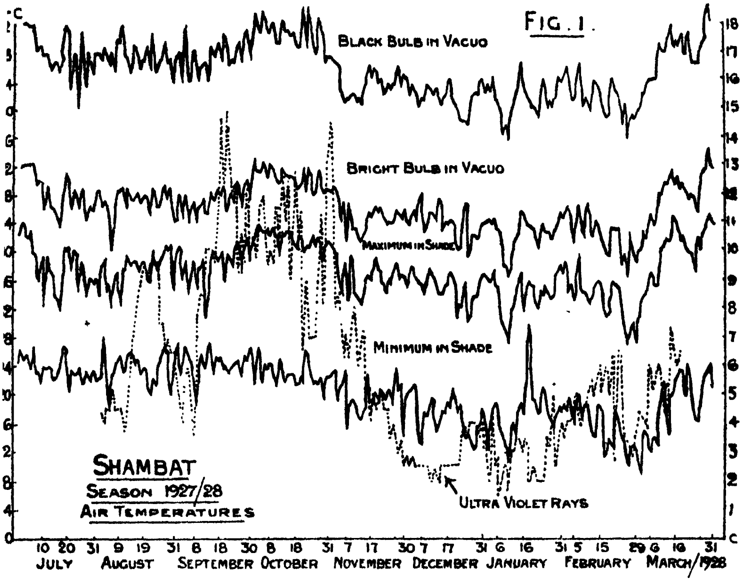
FIG. 1.
°C
BLACK BULB IN VACUO
BRIGHT BULB IN VACUO
MAXIMUM IN SHADE
MINIMUM IN SHADE
ULTRA VIOLET RAYS
SHAMBAT
SEASON 1927/28
AIR TEMPERATURES
U. V. R.
18
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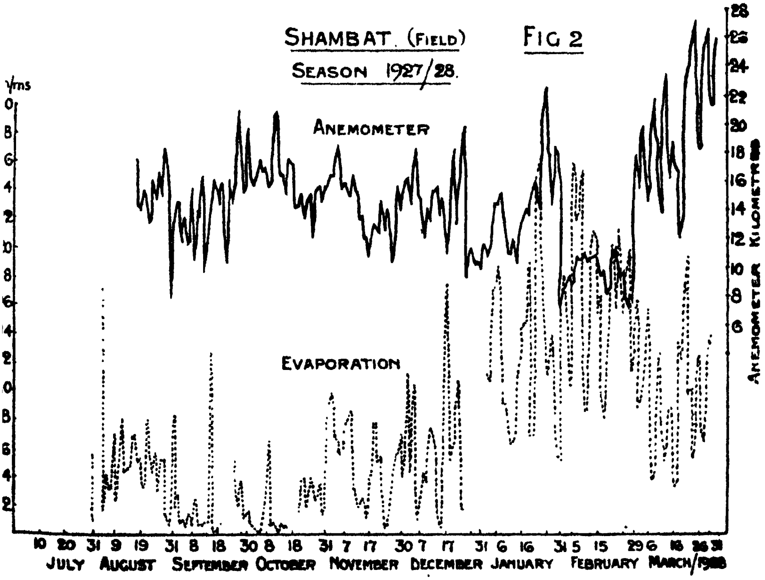
FIG 2
SHAMBAT (FIELD)
SEASON 1927/28.
ANEMOMETER
EVAPORATION
ANEMOMETER KILOMETRES
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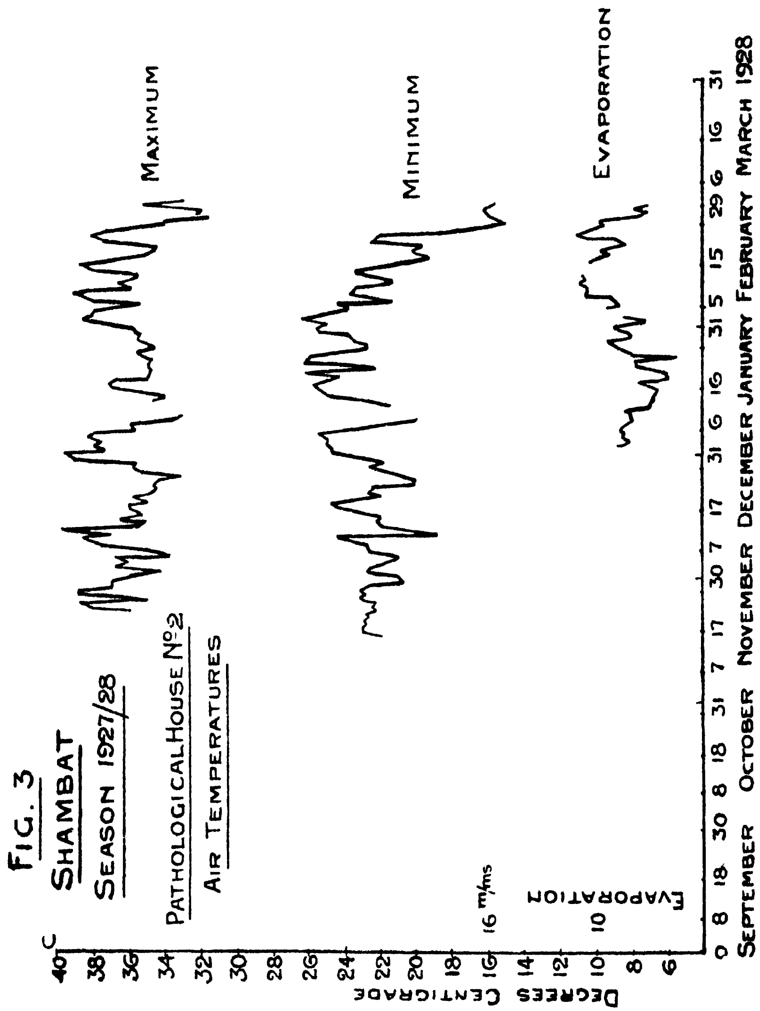


FIG. 3
SHAMBAT
SEASON 1927/28
PATHOLOGICAL HOUSE No. 2
AIR TEMPERATURES

FIG. 4.

RAINFALL, SOIL TEMPERATURE (5cms) & BACTERIAL DISEASE.
SHAMBAT, 1927.

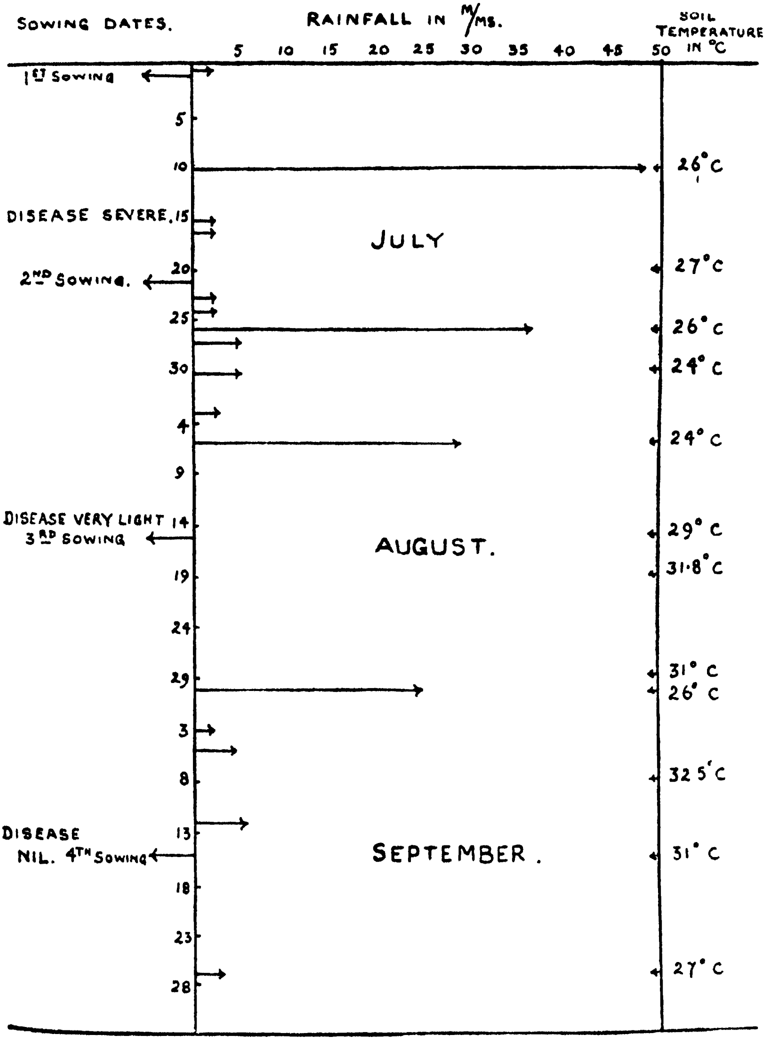


FIG 5

MARCH SOWN COTTON PLOT (1928)

MAXIMUM SOIL TEMPERATURE (SURFACE LAYER)

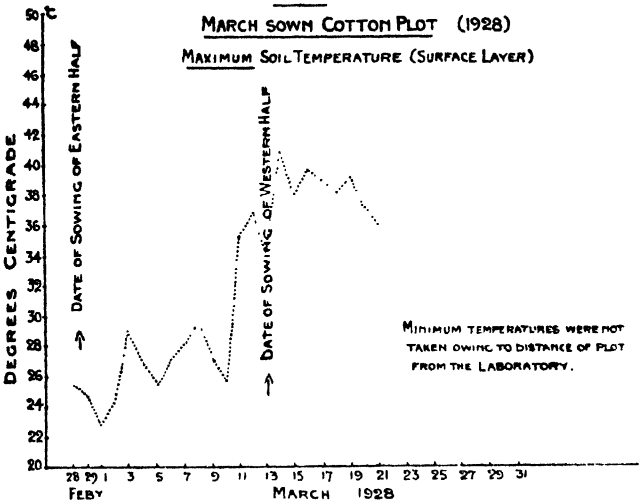


FIG 8

WAD MEDANI

RAINFALL 1907/1925

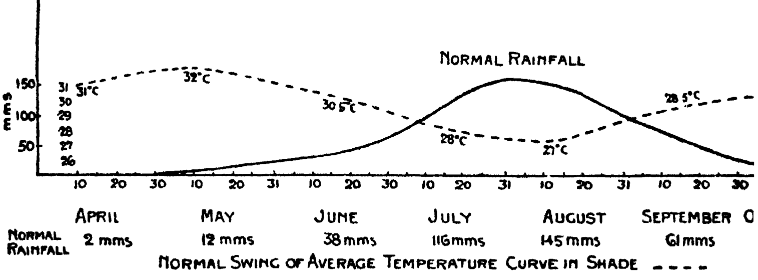


FIG 6

DARWISH.

CANABIA 40 PLOT SEASON 1928-1929

SOIL TEMPERATURE

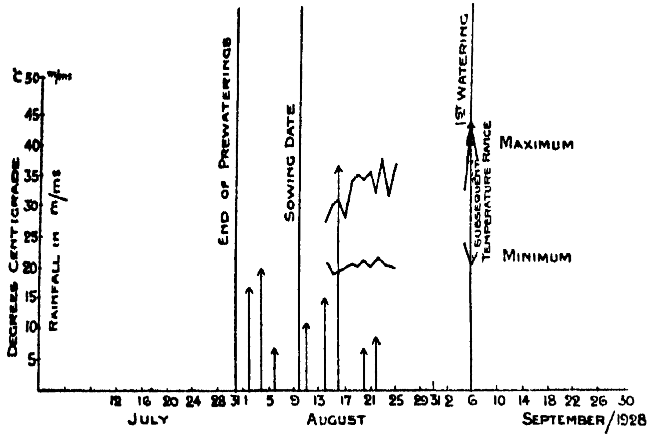


FIG 7

DARWISH

WAD EL NIAM PLOT

SOIL TEMPERATURE & RAINFALL

SEASON 1928/29

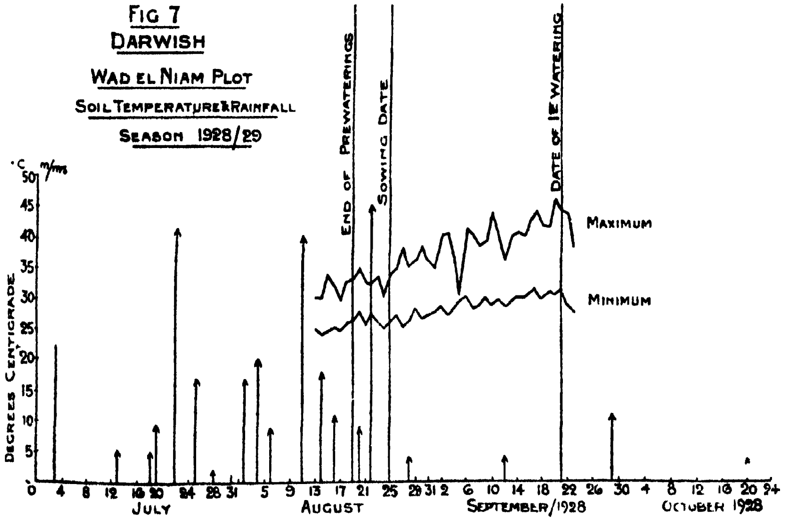
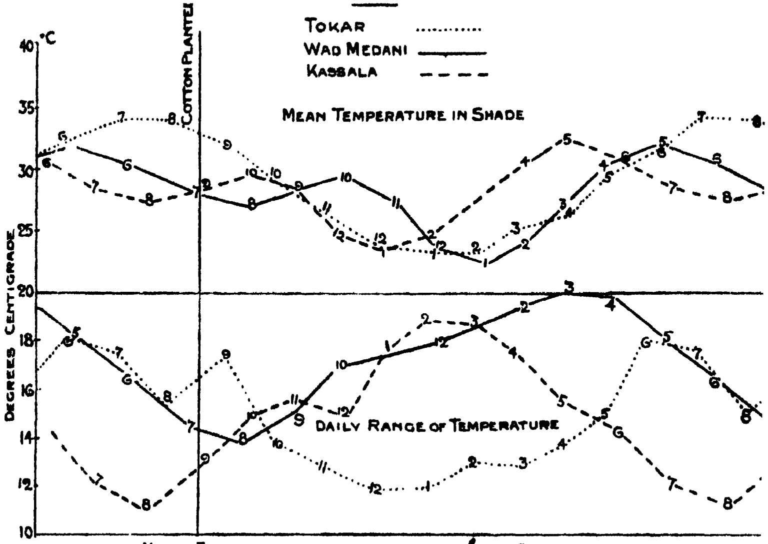


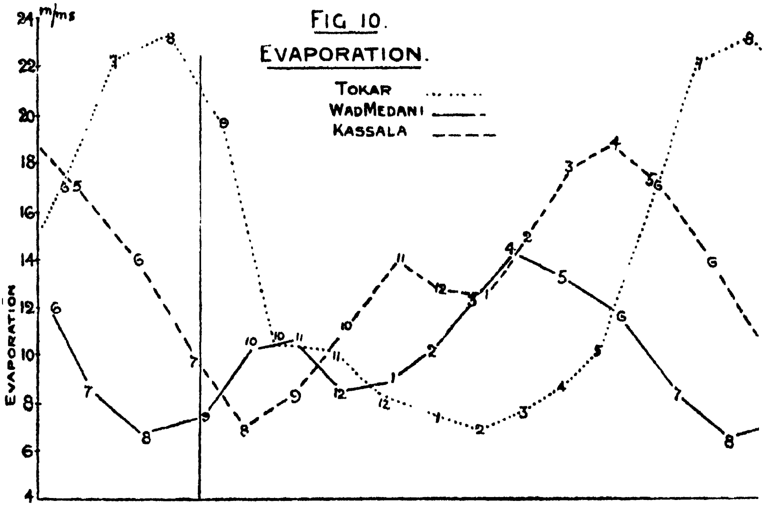
FIG 9



NOTE FIGURES INDICATE MONTH OF YEAR I E 5 = MAY ETC

FIG 10.

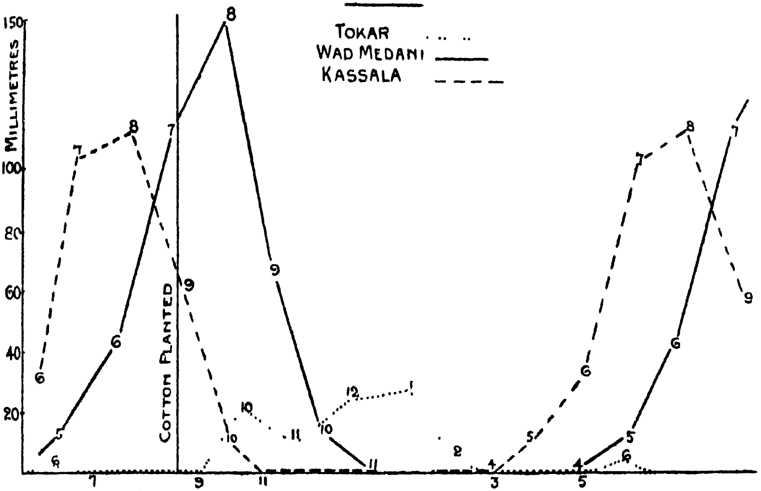
EVAPORATION.



NOTE . FIGURES INDICATE MONTH OF YEAR I E 5 = MAY ETC

FIG. 11

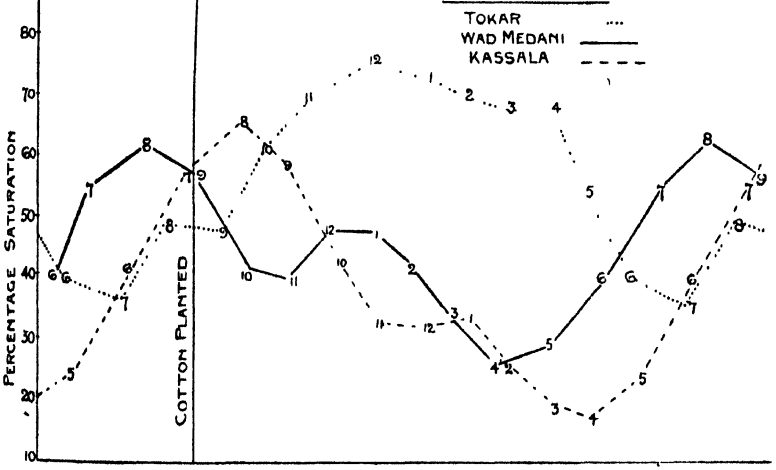
RAINFALL



NOTE. FIGURES INDICATE MONTH OF YEAR

FIG 12

RELATIVE HUMIDITY



NOTE. FIGURES INDICATE MONTH OF YEAR

THE MONEYLENDER

BY

W. GILHESPY.

Haji Shah stood on the flat roof of his house after reciting the morning prayers and glanced across the cotton fields. To the west and north of the village they showed white under the tender dawn, a fair sight that gave the village headman no pleasure. Too well he knew that the plants should have been stripped of their snow-white tufts of lint two days ago, and thus escaped damage from the sandstorm that had swept across the plain. Too well he knew the reason for the work being delayed, and a scowl darkened his strong face. His own cotton was stored and baling had commenced, but then he was not in the clutches of the moneylender!

Many of his neighbours were, and he suffered with them and for them as he made a rough calculation of the damage wrought by the dust-laden blast that had blown so many over-ripe bolls off the stems and filled the others with sand. He suffered as must those whose roots have taken firm hold of the soil, whose love for the land and all it grows is part of their being, who almost regard plants as sentient things.

The average Indian cultivator is content to follow time-honoured methods, to him innovations are anathema. He is a most difficult person to move, but there are some notable exceptions, men who are ready to move with the times, but cautiously, desiring to prove all things and to hold fast that which is good.

Of these was Haji Shah. The men of the Agricultural Department found him a ready but critical listener. Wearied and disheartened with trying to interest those farmers who were wedded to old methods just because they *were* old, they listened to his enquiries with satisfaction. He was not content with statements, he demanded proofs.

When an expert on cotton growing came to Banchabad the old man received him with grave courtesy—there is no more hospitable being than the Mohammedan cultivator of India. The specialist was enthusiastic. Haji Shah was sincere in his desire for knowledge, and readily agreed to try small samples of seed from several different sources.

He decided on an improved Egyptian variety supplied by the

Agricultural Department, and grew it with success. A year later he was growing no other, while his neighbours were still cultivating the same cotton as their great-great-grandfathers had grown. When the headman's profits proved that he had been right they followed his example. He sold them seed at a fair price and gave them the benefit of his experience.

Within four years the area of cotton around Banchabad had increased considerably, within six it had doubled, and the old man rejoiced. Conquest is as the wine of life to some ardent souls, and failure galls. Haji Shah looked on his neighbours' crops. and knew the joy of triumph and the bitterness of defeat. He had helped those men; he knew that he had helped the moneylender as well, and that it was Lal Chand's policy to ruin them.

That was his business in life. By Haji Shah's help the villagers had prospered, and several of them had broken the last of the chains with which the usurer had bound them. Naturally their freedom enraged Lal Chand, since only by keeping them in bondage could he continue to grow rich on their labours. Men who could pay for seed and labour without coming to him for assistance were men from whom he could make no profit. The poorer they were the harder the bargain he could drive with them.

He had a lien on some of their crops and, according to the bond on which he had lent them money, they could not gather them until he allowed them. He had refused them permission to pick their cotton until he had taken that portion to which he was entitled—at *his* price. Delay might result in the cotton being overloaded with sand, the over-ripe bolls might fall and the value of the crop be materially reduced—that was precisely what he desired. There could be no better way of riveting his victims' fetters firmly.

The headman decided to thwart him. He sent his servants to gather all the pickers they could, then went to Yusuf Khan, one of his neighbours, and advised him to begin picking cotton at once.

"But, Lal Chand," the other demurred, "he said he would come for his share first."

"Is the son of my old friend also a slave to the unbelieving dog of a bunnia?" the other demanded. "The spawn of hell will surely come—when there is no more of the crop worth picking than will pay him his dues. What need was there to borrow money from him?"

"I? I did not borrow. He claims money on an old bond given by my father to his father."

"I never knew."

"I was ashamed, I never told."

"Get thee to the cotton picking and pay nothing to Lal Chand until we have spoken together again. I go to help Mustapha Khan."

Lal Chand's spies warned him that certain debtors were picking their cotton, and he hurried to the field. Haji Shah saw him approach Yusuf Khan and went towards him. The usurer greeted him as cordially as though the headman were not a thorn in his flesh.

"This youth picks his cotton by my advice," the leader said in silky tones, but with the light of battle in his eye.

"But the—the agreement," the other stammered. "He owes me——"

"He owes thee nothing, and will pay nothing," and Haji Shah smiled sweetly when he saw that the shot had reached its mark. "Also the others will pick their cotton and pay thee such monies as are thy rightful dues."

"He will think of some other way of working evil," he told Yusuf Khan when the moneylender had gone. "We must act quickly and confound him. Shaitan, who is his father, will help him in his evil doings."

He was right. Lal Chand went to the judge of the Civil Court and obtained an injunction restraining his debtors from removing their cotton until his dues had been paid. Haji Shah urged them to ignore it and helped them with the picking.

"Are we followers of the Prophet or are we slaves of an unbeliever?" he demanded. To Yusuf Khan he said, "Pay him no money. He is a liar, for thy father borrowed nothing from him or his father. Now sue him in the court for the return of the money he hath had from thee on a forged bond. I, Haji Shah, will bear testimony against the son of a jackal."

He did. He had transacted business for Yusuf Khan's father when the man was disabled from partial paralysis, and produced letters received by him while still able to write.

"These," he declared, "were written by the father of Yusuf Khan, whose name was Abdul Kassim, son of Abdurrhaman. In the bond is written, 'son of Abdul Rahim.' Also he could not have signed any bond on the date there written, seeing that he could not use his hand and surely he would know the name of his father.

"He was in no need of money, for when he died there remained in my hands some five thousand rupees, some of which—about two thousand—I spent according to his instructions, giving an account thereof, and the balance of the money to his son, Yusuf Khan."

Other witnesses bore out the patriarch's statement, and Lal Chand was glad to pay back the amounts he had wrongfully received. He escaped punishment by pleading that the bond had been given to his father, whose business he had inherited. It was a lie, and the judge knew it, but, without irrefutable proof of fraud, he was unable to convict the usurer.

Then the suit he had filed against the cultivators was heard. They admitted their liability, but pleaded for time to pay and that they be allowed to sell their own cotton, proving that in previous years the moneylender had taken undue advantage by fixing an absurdly low price on such crops as he had seized.

Their plea was granted, and Lal Chand left the court filled with shame and rage. Not shame for what he had done and tried to do—but for having failed and been laughed at by his own dupes. The petty tradesmen in the villages, most of whom were under his thumb because they owed him money and because he was able to control prices and could ruin them, no longer treated him with unbounded respect. His brothers in the profession either reviled him or gave him the cold shoulder. Soon he learned that Haji Shah had another rod in pickle for him.

The village headman has no legal standing, but an able man who acts uprightly and for the good of the community wields tremendous influence, especially if he is possessed of moral courage. Haji Shah decided to lead an attack against the moneylender from another quarter.

All the crops were sold locally, and at such prices as the cultivators could wring from the bunnias, who, it was well known, were either agents for the usurer or under his power. Those whose crops had been taken in payment of interest were compelled to accept such prices as their virtual masters allowed. Those who were free of debt were in a better position to drive a bargain, but even these had to be content with prices far below the market value.

Haji Shah wrote to the cotton expert for advice and was informed that the Government had arranged for auctions to be held near Bombay. Several of the zemindars combined and received prices for their cotton at the auction far beyond what they had ever obtained locally.

" Ho ! ho ! ho !" they chuckled. " No longer need we sell to that son of a thief. Why should we not send all the cotton grown in the district to the Government sales ? Thus would we save on the rail charges, besides helping those who cannot help themselves."

So the scheme was agreed on, and there was jubilation among the cultivators. But it was short-lived. They had millet, pulse, maize, wheat and tobacco to sell, and those who had hitherto bought them now either refused to purchase or offered a very low price. They tried to find sale in distant villages, but Lal Chand had forestalled them. His influence was far-reaching, and he was determined to maintain his power over the cultivators. They held a council of war in Haji Shah's guest house.

"We cannot grow cotton on the same land year after year," he reminded them. "We must grow other crops as well, and we must sell at a profit if we are to live. We can send cotton down country, but we cannot send other stuff so far unless we combine and sell all—all we grow. It will be no easy task," he admitted. "We will spend much money on rail charges, so much that there will be little profit left. We are at war with Lal Chand—shall we bow the knee to him? Shall we give unto him and his agents the bread which Allah hath provided for our children? Are we dogs that we should come and go at their call, or eat that which they choose to leave? These bunnias are thieves by birth and by training. Their fathers and their fathers' fathers have gained great store of wealth by trickery. Yet they are useful if they will but be content to buy and sell at a fair price, leaving us, to whom Allah hath given land, to raise food for man and beast. If they will not, then we must work together and defeat them. Now there are among us men from five villages and—— But where are the headmen from Sarrankot and Fassipoor?"

"They have gone with trackers to help the sahibs who came to shoot the tiger. The beast hath slain a woman near Sarrankot."

"So? And many more besides. May Allah guide their aim! Well, we must defeat this Lal Chand or he will eat us, even as the tiger hath eaten *his* victims. Therefore we will wait until the others come and we can all hold council together."

Fruit, cakes, sweets and cooling drinks were brought, the great water-pipe was passed from hand to hand. Those who had far to go took a courteous farewell of the headman, and the others sat longer. Haji Shah accompanied the last of these to the gates of the courtyard, and while watching him ride away, a messenger, whose horse's heaving flanks showed that he had travelled fast, galloped up.

"Greetings to thee, O Haji Shah, and may peace be upon thy house!" he began. "Two sahibs have come to slay the tiger who hath killed many, and they bid me say unto thee that the striped terror of the jungle hath been tracked to the ford which is on thy land, and hideth in the thorn brake near the path. If, therefore, travellers be warned not to pass that way and no cattle graze there, he will remain in hiding until the sahibs can reach the spot."

"My cattle are beyond the sandhills, and I will post watchers to see that travellers are warned to go by the bridge, avoiding the ford. Stay thou and eat."

"My thanks for thy courtesy, but I must hasten."

The messenger swung himself into the saddle as the moneylender rode up. Lal Chand bowed with unctuous obsequiousness to the man he hated, and spoke.

"I go to Fatehganj by the ford. Is the road safe?" he asked. "It hath been told to me that the striped one hideth near the bridge."

"Go in peace, and may good fortune go with thee, Lal Chand! Take the road by the ford."

"He carries his saddle bags full of account books," the headman muttered as the usurer's pony ambled along the jungle road leading to the ford. "He will swear lie upon lie in the court—unless the striped one slay him. Let tiger eat tiger. The one is as ravenous as the other."

He was still waiting to warn travellers of the danger that lurked near the ford when Lal Chand's pony galloped towards him, maddened with fear and with deep claw marks on its bleeding shoulder. He advanced with outstretched arms and drove the terrified beast through the gates; then he closed them, dressed the pony's wounds and examined the moneylender's books.

"I think the men of my village have paid enough in usury," he said as he made a bonfire of the accounts.

A smile lit his austere face as he carried the great tobacco pipe to the shade of a tree and puffed contentedly. Three rifle shots in rapid succession, followed by the shrill trumpeting of a tame elephant and the exulting cries of the villagers, told him that the white men had rid the jungle of the tiger. Haji Shah had rid the villagers of the other tiger and felt at peace with all the world.

COTTON DISEASES IN UGANDA, 1926-1928

C. G. HANSFORD, M.A.,
Government Mycologist.

PART II.

VIII.—Boll Rot due to *Bacterium Malvacearum*.

The attack of this organism on the leaves and stems of the cotton plant has already been dealt with in Part I. On the bolls the attack first shows up as small round water-soaked areas on the surface of the boll wall. Usually no signs of epidermal injury are apparent. These spots enlarge gradually, until in some cases the greater part of one side of the boll wall may be involved. As a general rule, the spots do not exceed 1 to 1·5 cm. in diameter. At the same time the centre of the water-soaked area commences to collapse, without breaking the epidermal layer, and turns darker. Finally, the spots show a sunken centre from dark purple to almost black with a bright purple margin, and covered with the wrinkled epidermis. The inner tissues of the boll wall are collapsed and filled with bacterial slime.

In young bolls attacked by this disease, the bacteria penetrate into the lint cavities and the young lint develops a yellow colour and becomes sticky. When older bolls are attacked, the bacterium often remains confined to the tissues of the boll wall, and the lint is unaffected, except that the disease often causes premature opening of the boll due to the drying out of the affected areas, with the consequent exposure of the immature lint, which subsequently becomes invaded by saprophytic or semi-saprophytic fungi such as *Monilia carbonaria*, *Fusarium* spp., *Cladosporium herbarum*, and *Alternaria* spp. In such cases the lint is so damaged and stained by these fungi that it is worthless.

When very young bolls are affected, the bacteria may penetrate into the lint cavities before the lint is developed, and in such cases the lint may be partially or completely suppressed. Often the bacteria in very young bolls penetrate into the young seed, and the whole of one or more locks of the boll may be reduced to a dark coloured sticky mass. It is thus evident that the extent of damage caused in affected bolls depends largely on the age of the boll when first attacked. In the case of bolls attacked after the lint is practically fully developed, the damage is limited to the boll wall, and the lint often remains unaffected, whereas in young bolls the whole interior of the boll may be completely rotted by the bacterium.

Field observations during both the abnormally wet season of 1926-7 and the abnormally dry season of 1927-8 appear to indicate that at present in Uganda this boll disease is of secondary economic importance; while its distribution is almost universal, the actual number of bolls affected in each field is usually insignificant.

The results obtained from artificial inoculations of cotton bolls with *B. malvacearum* have proved very inconclusive. During the dry season, 1927-8, it was found very difficult to obtain successful infections by spraying the organism on to healthy bolls of any age. At the same time, a few natural infections were taking place in the same experimental plots. By wounding the surface of the bolls with a fine needle and then spraying with the bacterium, infection took place readily, but only in roughly 40 per cent. of the total inoculations. It is possible that the very dry, sunny weather may have been the controlling factor in these experiments, as the bacterium in culture is rather sensitive to the action of light. In the moist season of 1926-7, inoculations on the wounded surface of cotton bolls were more successful, amounting to about 60 to 70 per cent. of the total number of bolls inoculated. In experimental inoculations by spraying the bacterium on to healthy unwounded bolls during this damp season, infection amounted to only 20 per cent. of the total.

It thus appears possible that in nature in those few fields where this disease is at all prominent, some other factor has operated to promote successful infection. In these cases it is possible that the larger percentage of infected bolls may be due to the action of insects in either wounding the boll surface or in actually introducing the organism into the tissues. Experiments are now being devised to attempt to elucidate any possible relation of this disease in the field with various insects known to attack cotton bolls in Uganda. In this instance *Dysdercus* would appear to be ruled out, as were the organism associated with this insect one would expect to find the majority of cases of the disease in the interior of the bolls, similar to the infections of *Nematospora,* whereas actually in the field external infections on the boll wall are by far the most frequent form of attack by *B. malvacearum,* and only at a late stage do these appear to develop internally in the lint cavities and in the seed.

Distribution of Cotton Seed.—Samples of ginned cotton seed have been examined during the past two years both by Mr. J. D. Snowden and by the present writer. In several instances evidence has been found of internal infection by *B. malvacearum,* which has been more than once obtained in pure culture from such seed. Infection occurs both on the cotyledons as water-soaked patches and on the radicle of the seed. In the latter case, the young root is often completely rotten, and the seed does not germinate. Where infection is limited to the cotyledons, the seed germinates normally, but the cotyledons show circular or oval patches of infection as soon as they appear above the soil. Although the dissemination of *B. malvacearum* internally in the seed has thus been proved to take place in Uganda, we are still in the dark as to how the infection reaches the interior of the seed. Such infected seed often shows no damage on the outside of the seed coat. Internal infection may take place before the seed is ripe, and while it is still enclosed in the boll, or may take place after the opening of the bolls, or alternatively after the seed has been ginned during the storage period intervening before the seed is planted. Little evidence is at present available here as to which of these actually represents the facts.

It seems rather improbable from the little evidence to hand that infection takes place while the seed is still enclosed in the boll, for the reason that in those bolls in which infection has reached the lint cavities at an early stage, the lint does not develop normally, and often the whole contents are rotted. Such seed would not reach the ginnery.

A number of bolls have been found from time to time in which the infection of *B. malvacearum* has penetrated into the lint cavities too late to suppress the normal development of the lint, which has merely been stained yellow, and contains a sticky mass of the bacterium. Such lint, when dry, would be transported to the ginnery by the natives separately as stained cotton. Examination of the seed in such bolls under the microscope has so far revealed no sign of infection of the cotyledons or radicle by the bacterium. In spite of this negative evidence, the writer is of opinion that it is probable that *B. malvacearum* enters cotton seed in this manner, and that the infected seed found originates in this way. The other possible explanations of internal seed infections are that the infection takes place after the opening of the bolls, either while the seed is still attached to the parent plant or after ginning. In either of these cases the seed is ripe and enclosed within a hard testa, so that for infection to take place in such seed would imply penetration of the testa, most probably by some insect agency. On newly opened cotton bolls both *Dysdercus* and *Oxycarenus* are very common in Uganda, and the former occurs in thousands on the piles of ginned cotton seed accumulated at the ginneries during the season. Experiments are being laid down to attempt to determine whether or not such insects are able to introduce the bacterium into ripe seed at these periods, but till more information is available nothing definite can be said as to the manner in which internal infection of cotton seed by *B. malvacearum* takes place.

It has long been known that delinting cotton seed with sulphuric acid before planting will greatly reduce the amount of infection appearing on the seedlings. This indicates that the greater part of the infection is due to transmission of the bacterium on the outside of the seed, and that as a rule the transmission internally is not of great economic importance. In Uganda, however, the various forms of disease caused by *B. malvacearum* are not yet of sufficient economic importance to warrant the expense of delinting.

IX.—OTHER BOLL DISEASES.

During the course of the experimental work on *Nematospora* boll rot in Uganda, the writer isolated from the interior of diseased cotton bolls a number of fungi and bacteria. In many cases these were associated with *Nematospora* in mixed infections, but in others the organisms were found in pure culture inside the bolls. Some of these bolls showed signs of external damage to the walls, but often the disease symptoms were parallel to those of *Nematospora* infections. All these can be classed as forms of " Internal Boll Disease," though the majority of the organisms are of only occasional occurrence in cotton bolls. The following organisms were found by the writer inside cotton bolls: *Alternaria longipedicellata*, Reichert; *Rhizopus nigricans*, Ehrenb; *Cladosporium herbarum*, Link; *Fusarium moniliforme*, Sheld; *Fusarium sporotrichioides*, Sherb; *Fusarium diversisporum*, Sherb; *Fusarium anguioides*, Sherb; *Fusarium* spp. of section *Elegans*—two strains; *Aspergillus tamari*; *Mucor* sp; *Monilia carbonaria*; Bacteria cultures AE1, AW2, L2, AO1, AO2, AF2, Z1, Y1, AH2, BM1.

Inoculation experiments were conducted with each of these organisms to determine their pathogenicity and, if possible, the conditions under which each is able to penetrate to the interior of the boll. Of the organisms enumerated above, the following proved incapable of attacking the tissues of cotton bolls, even when inoculated into the interior of the boll by a hypodermic syringe: *Cladosporium herbarum*; *Fusarium sporotrichioides*; *Fusarium diversi-*

sporium; *Fusarium anguioides*; *Mucor* sp.; *Aspergillus tamari*; *Monilia carbonaria*; Bacteria cultures L2, M1, Y1, Z1.

The above organisms appear to be entirely of secondary importance and to depend on the attack of other fungi or bacteria. They are of common occurrence on bolls which have opened prematurely, and in wet weather grow amongst the fibres of the lint of opened bolls. All are common in the fungus flora of the exterior of cotton bolls in both dry and moist weather.

Alternaria longipedicellata (Reich.), Mason.—All experiments on this fungus, as well as with the other fungi and bacteria dealt with below, were carried out either in the open air or under mosquito wire cages to exclude insects. Under such conditions it appears from the results of all inoculation work carried out by the writer that this fungus is unable to grow through the boll walls, even when these are injured by pricking the surface with a needle. When a small hole is made by means of a fine needle penetrating into the boll cavity, the fungus proved capable of growing in the minute droplet of liquid exuded through the damaged tissues, and finally grew through the hole into the boll cavities, where it set up a dry rot of the lint. No evidence of penetration into the seed was obtained from inoculated bolls.

Inoculation experiments with a hypodermic syringe gave 100 per cent. of successful infections with this fungus.

In the field infection of unopened bolls with this fungus is very rare, and is apparently dependent on external damage to the boll wall, especially that to the epidermis caused by the spiny bollworm (*Earias*), which has a habit of chewing the superficial tissues of bolls without finally penetrating into the interior.

The fungus is of very common occurrence on the outside of cotton bolls, and also causes staining and deterioration of the lint of opened bolls in wet weather when these have to be left on the plant.

Rhizopus nigricans, Ehrenb.—This fungus has also been proved to be a wound parasite of cotton bolls, similar to the *Alternaria* above. It causes a rotting of the lint, and when introduced into very young bolls the whole contents are affected. After the hardening of the seed coats inside the boll, it appears that *Rhizopus* can penetrate into the interior of the seeds only with great difficulty, if at all. No infection was obtained with this fungus, except when deep wounds penetrating to the boll cavity were made in the boll walls.

Fusarium moniliforme, Sheld.—This fungus is of common occurrence in bolls affected with *Nematospora* disease in Uganda, but a number of cases have been found in which the *Fusarium* was un-accompanied by other fungi and bacteria. Inoculation experiments indicate that this is also a wound parasite of cotton bolls. It readily grows through deep needle wounds into the interior of the boll, and sets up a dry rot of the lint. The latter is partially disorganized and the fibres readily break up. Examination under the microscope shows that the walls of the fibres are attacked by the fungus. Penetration into the seed takes place in young bolls, and the fungus is also quite common as an internal parasite of mature seed.

Fusarium spp. of Section Elegans.—Two strains have been isolated apparently from the interior of cotton bolls. In these cases the lint of attacked bolls was distinctly pink in colour, and the cell walls were partially disorganized. Inoculations proved that one of these strains was a wound parasite of cotton bolls, similar to *F. moniliforme* above, but the pathogenicity of the second strain is doubtful.

The Internal Bacterial Flora of Diseased Cotton Bolls.—Altogether ten different strains of bacteria have been isolated by the writer from diseased cotton bolls in Uganda. Affected bolls show in every case a yellow discoloration of the lint in bolls attacked at a late stage of development, and the lint is usually sticky from the bacterial slime. The yellow pigment appears to be a product of the host, though it is worthy of notice that in inoculation experiments only yellow bacteria gave any positive results. Three cultures isolated from diseased bolls—namely, L2, Z1, and Y1—gave no indication of pathogenicity when injected into healthy bolls. These three strains gave dirty white colonies on most agar media in culture, where all the other strains gave yellow colonies. The former are evidently to be classed as secondary invaders of the bolls, or at least are dependent on the damage caused by other organisms.

The yellow group of bacteria comprise *B. malvacearum* discussed above, and seven other strains here designated as cultures AQ1, AQ2, AE1, BM1, AF2, AW2, AH2. It is convenient here to give a general description of the whole series of cultures, and merely to note where necessary any deviation from the type:

Vegetative cells rod-shaped, short, with rounded ends, usually in pairs (AW2 in chains of 4 to 6), on both liquid and solid media. No spores were found in any culture. Rods motile by a single polar flagellum. Gram negative.

Agar Slant: Growth spreading, flat to slightly raised, crenate to smooth margin, smooth, glistening, opalescent to opaque, viscid almost dry, pale canary yellow, no odour, no coloration of medium.

Agar Colonies: Circular, pale yellow, flat to slightly raised, thin, smooth or with slight radiating "valleys," growth rapid, with slightly crenate margin in BM1, otherwise entire.

Agar Stab: Growth best at top; surface growth abundant, spreading. Puncture filiform with slightly uneven edges; no liquefaction.

Nutrient Broth: No surface growth, no clouding, copious yellowish precipitate, very finely divided, cloudy on shaking, odourless. In AW2 the precipitate is rather more flocculent than in the other strains.

Litmus Milk: (AW2) acid reaction: clearing above, but no coagulation, consistency unchanged. Cultures AF2, AQ2, BM1, AE1 give alkaline reaction, no clotting or clearing. Culture AQ1 gives slight acid reaction with partial clotting.

Fermentation Reactions.—Cultures AQ1, AE1, BM1, AO2, AF2, AW2, AH2 give acid but no gas from dextrose.

Cultures AQ1, BM1, AQ2, AF2 give no acid or gas from lactose, maltose, mannit.

Culture AW2 gives a very slight acid reaction but no gas with maltose, but none with lactose or mannit.

Culture AE1 gives an acid reaction but no gas with lactose, none with maltose and mannit.

Starch: Clear starch agar-growth normal in every case, but slightly less than on other media.

Saccharose: Cultures BM1 and AF2 give no acid or gas with saccharose. The other cultures (AQ1, AQ2, AE1, AW2, AH2) give acid reaction on saccharose, but no gas.

Nitrates are not reduced by any of these strains. A slight *indol* reaction is obtained with AW2, but none with the other strains.

Pathogenicity of Cultures.—Of the seven strains of yellow bacteria enumerated above, Culture BM1 proved non-pathogenic to cotton bolls. Three series of inoculations of twenty bolls each were carried out with this strain, one series being sprayed with a suspension of the bacteria in water, a second series treated similarly but also wounded on the surface by a fine needle, and the third series inoculated into the lint cavity by a fine hypodermic needle. In no case did any symptoms of disease appear.

Cultures AF2 and AH2 gave successful infections only in the second and third series of inoculations, where the needle had penetrated through the boll walls to the internal cavity, as evidenced by the proliferation of the interior layers of the boll wall. In the series inoculated with a hypodermic syringe, a dark-coloured sticky rot was set up in the interior of the boll, and in the case of young bolls this involved the whole of the inoculated lock of the boll, but in more mature bolls was limited to the area immediately surrounding the site of inoculation. In all cases the infection was limited to the interior of the boll, and the tissues of the boll wall remained healthy. Evidence available at present indicates that the interior of the seeds in inoculated bolls is not affected by this bacterium, except in those cases where the needle penetrated the testa, when a soft rot of the embryo is set up and the seed contents are completely disorganized.

Cultures AO1, AO2, and AW2.—No infections were obtained by merely spraying these cultures on the surface of uninjured bolls. Even where the superficial layers of the boll walls were injured by a fine needle, no infection resulted; but where the needle was allowed to penetrate to the interior of the boll, infection readily took place in every instance. By using a hypodermic syringe, infection took place in every inoculated boll. In this series the whole of the inoculated lock was involved in a dark-brown rot, converting the lint to a soft sticky layer closely adherent to the testa of the seeds. The interior of the seeds in the older bolls inoculated was not affected by the rot, except where the testa had been penetrated by the inoculating needle, when the whole seed contents were rotten.

In young bolls inoculated by means of a hypodermic syringe the damage was more extensive, often involving all the locks. Considerable malformation of the placenta and the interior took place; the interior surface of the walls was dark yellowish-brown with small raised black spot about $\frac{1}{5}$ mm. in diameter; and often seeds and lint were partially or completely prevented from developing.

Culture AE1.—Successful infections with this bacterium were obtained only by means of a needle or hypodermic syringe penetrating into the lint cavities. The rot caused was, as a general rule, less extensive than with the preceding cultures AQ1, AO2, and AW2, though of the same type.

Where only superficial damage was caused to the boll wall by pricking with a fine needle, a small raised corky scab was produced at each prick. No evidence was obtained of bacterial infection of such scars, and they are probably of purely mechanical origin.

In a considerable percentage of all bolls inoculated with a hypodermic syringe other organisms were found associated with the bacteria used for inoculation. The most frequent of these are species of *Fusarium, Cladosporium herbarium, Alternaria longipedicella,* and another species of *Alternaria* at present unidentified.

In the field bacterial rots of the interior of cotton bolls are less common in occurrence than that due to *Nematospora.* In the experimental plots kept under observation during the cotton season 1927-28 the relative frequency of rots caused by *Nematospora* and bacteria of all kinds was roughly 30 to 40: 1. All available evidence points to the conclusion that these bacterial rots of cotton bolls are of much less importance in Uganda than that due to *Nematospora.*

(*To be continued.*)

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

Following our regular schedule, we give in this issue the World's Crops, with details of the American and Egyptian crops. We also repeat the diagram of the World's Crops brought down to date.

As will be seen from Table I., the total world's supply for season 1928-29 is promising fairly well, the present estimates being nearly 2 million bales above the previous season. This brings it practically up to the pre-war record of 1914, which has only been exceeded twice, in 1925 and 1926, when the American crop made its dramatic recovery; but this, unfortunately, proved to be very short-lived. The most satisfactory feature of the world position is the slow but, on the whole, steady increase of the other crops. This, of course, was severely checked in 1927 by the low world price of cotton, due to the huge American crop of 1926; but in the current season most of them have made a good recovery. Thus the third forecast of the Indian crop puts the crop at 5,996,000 bales, so that the final result may not be very far short of the record crop of 6,215,000 in 1925, though recent abnormally cold weather is reported to have damaged the crop in Gujerat.* The Egyptian crop may also prove larger than the present A.G.P.A. estimate; the Government ginnings to January 31 are nearly 2,000,000 kantars above last year's figure for the same date; and it would not take much to make it exceed pre-war records. Comparison with the post-war records of 1925 and 1926 is, as we have previously pointed out, very difficult, owing to the uncertainty as to the up-country carry-over in these two seasons. The Russian crop has also been making a very steady recovery in recent years, and is now almost up to pre-war figures. The figures for China are, of course, always problematical; but it may be hoped that the present estimate for 1928 represents the worst results of the recent political disturbances, and that a good recovery may now be looked for.

American Crop.—Once more the Government crop statisticians at Washington have achieved a signal success in the accuracy of their forecasts throughout the season, and the December estimate of 14,378,000 bales is not likely to be much altered by the final figures; though it is reported that the average bale weight is running heavy this season, which might raise the figure to about 14,500,000 bales, or even a little more. The linters figure should also be a little higher than last year. As will be seen from Table II., the recovery of the crop in 1928 was due to a substantial increase of the acreage, for the average yield per acre, as at present estimated, was the lowest since 1923. This, as usual, was mainly due to weevil damage; but there were other disturbing factors, of which the extension of rootrot in Texas may be specially mentioned because of the threat to future crops. The weevil position remains very unsatisfactory. The attack was undoubtedly severe, and there is so far no reason to expect that it will not be as bad in 1929, for the number that went into hibernation was large, and so far there has been a marked absence of cold weather during the winter to reduce the chances of survival.

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* The "Final" Estimate of the Indian crop makes the area 25,874,000 acres but the crop only 5,204,000 bales. It seems, however, that the crop figure includes nothing at all for the Gujerat crop, owing to the impossibility of estimating the result of the recent frosts. As the *acreage* for Gujerat is apparently included, this makes the usual calculation of average yield per acre quite misleading, and the full facts will not be known until the supplementary report appears late in April.

Egyptian Crop.—The most striking feature of the Egyptian crop this year is the steady increase of the area under Ashmouni and Zagora, mostly at the expense of Sakel.

The Government's estimate of the total crop so far is only 7,196,000 kantars, but the Alexandria General Produce Association puts it at 7,500,000, and other private estimates are even higher. On the A.G.P.A. figures it would mean an average yield of 4·31 kantars per feddan, which compares favourably with 4·02 last year, but is, of course, far below the high figure of 4·84 based on the actual arrivals of 1926, though here again the question of the carry-over affects the reliability of that figure. There is, however, no getting away from the fact that the average yield per feddan in Egypt is apparently rising again, and this in turn is largely due to the increasing proportion of Uppers, of which the average yield is normally much heavier than Sakel. It must be remembered that not only is Ashmouni to some extent replacing Sakel, but also that the great bulk of the increase in the total acreage is in Upper Egypt. Further, a great deal of work has been done in recent years towards the improvement of Ashmouni and the selection of new varieties, which is probably helping to raise the average yield in Upper Egypt. Everything therefore points to the possibility of a continued increase in the average yield over Egypt as a whole.

In discussing the Egyptian situation it is essential nowadays to keep in view also the Sudan crop, and we have therefore added to the Egyptian table a column containing the most reliable statistics available for the Sudan crop throughout the period of the table. The [illegible] point in these figures is the very satisfactory increase of the crop in recent years, especially since 1925, when the benefit of the new Blue Nile Dam at Sennar was felt in the Gezira crop. In view, however, of the decreasing proportion of Sakel in the Egyptian crop and the fact that the Sudan crop is also not all Sakel, the following attempt at an estimate of the world's supply of cotton of approximately Sakel quality (including Pima, Arizona, cotton) is of interest.

Kantars of 100 Lbs (approximately), 000's Omitted.

Season	*Egypt*	*Sudan.*	*Arizona.*	*Total.*
1924-25	2,800	114	22	**2,936**
1925-26	3,700	425	103	**4,228**
1926 27	3,150	570	78	**3,798**
1927-28	2,500	472	121	**3,093**
1928-29	2,750	585	125	**3,460**

TABLE I.—THE WORLD'S COTTON CROPS, 1902-28.

BALES OF 500 LBS. (APPROXIMATELY) 000'S OMITTED.

	America		*Per Cent. of World Total.*	*India.**	*Egypt.*	*Russia.*	*China.*	*Others.*	*Total.*
	Lint.	*Linters*							
1902 03	10,631	196	63	3,367	1,168	312	890	801	17,305
1903-04	9,851	195	61	3,161	1,302	477	800	751	16,537
1904-05	13,438	242	66	3,791	1,263	536	756	803	20,829
1905-06	10,575	230	61	3,416	1,192	604	788	938	17,743
1906-07	13,274	322	60	4,934	1,390	759	806	1,027	22,512
1907-08	11,107	268	62	3,122	1,117	664	575	950	18,433
1908-09	13,242	345	64	3,692	1,150	685	1,000	971	21,085
1909-10	10,005	310	54	4,719	1,000	663	1,419	950	19,066
1910-11	11,609	397	55	3,889	1,515	879	2,589	968	21,846
1911-12	15,693	558	64	3,288	1,485	873	2,552	1,058	25,507
1912-13	13,703	610	58	4,610	1,507	892	2,298	1,160	24,780
1913-14	14,156	639	57	5,066	1,537	980	2,303	1,287	25,968
1914-15	16,135	857	60	5,209	1,298	1,164	2,363	1,154	28,180
1915 16	11,192	931	57	3,738	961	1,407	2,057	984	21,270
1916-17	11,450	1,331	58	4,489	1,022	1,110	1,714	1,027	22,143
1917-18	11,302	1,126	59	4,000	1,262	603	1,863	1,086	21,242
1918-19	12,040	930	59	3,972	964	420	2,203	1,298	21,827
1919 20	11,421	608	53	5,796	1,114	274	1,914	1,484	22,611
1920-21	13,440	440	64	3,600	1,206	121	1,667	1,406	21,880
1921-22	7,954	397	51	4,485	972	57	1,263	1,310	16,438
1922-23	9,762	608	52	5,073	1,243	50	1,884	1,500	20,120
1923-24	10,140	668	52	5,161	1,306	214	1,744	1,746	20,979
1924-25	13,628	897	55	6,088	1,455	465	1,882	2,064	26,479
1925 26	16,104	1,115	58	6,215	1,593	711	1,796	2,139	29,676
1926-27	17,977	1,158	63	5,025	1,727	790	1,473	2,135	30,285
1927-28	12,956	1 016	54	5,871	1,219	925	1,812	2,051	25,850
1928-29	*14,373*	*1,100*	*55*	*5,996*	*1,500*	*1,100*	*1,550*	*2,200*	*27,819*

*** 400 lb. bales.** **Estimates in italics.**

TABLE II.—AMERICAN ACREAGE, CROP YIELD PER ACRE, AND PRICE, 1911-28.

Season.	*Acreage Harvested* (000's).	*Crop (Running Bales, 000's).*			*Average Yield* (*Lbs. per Acre*) (*Ex Linters*).	*Average Price Middling* (*Pence per Lb.*).
		Cotton.	*Linters.*	*Total.*		
1911–12	36,045	15,553	556	16,109	207·7	6 09
1912–13	34,283	13,489	602	14,091	190·9	6·76
1913–14	37,089	13,983	631	14,614	182·0	7·26
1914–15	36,832	15,906	832	16,738	209·2	5·22
1915–16	31,412	11,068	945	12,013	170·3	7·51
1916–17	34,985	11,364	1,300	12,664	156·6	12 33
1917–18	33,841	11,248	1,096	12,345	159·7	21·68
1918–19	36,008	11,906	910	12,817	159·6	19·73
1919–20	33,566	11,326	595	11,921	161·5	25·31
1920–21	35,878	13,271	429	13,700	178 4	11·89
1921–22	30,509	7,978	382	8,360	124 5	11·37
1922–23	33,036	9,729	591	10,320	141·5	14·92
1923–24	37,123	10,171	640	10,811	130·6	17·66
1924–25	41,360	13,639	858	14,497	157·6	13·76
1925–26	46,053	16,123	1,044	17,167	167·2	10·77
1926–27	47,087	17,755	1,042	18,977	182·6	8·15
1927–28	40,138	12,783	875	13,658	154·5	11 17
1928–29	45,326	*14,373**	*1,000*	*15,373*	*151 8*	—

* December estimate.

TABLE III.—EGYPTIAN AREA, CROP, YIELD, AND PRICE, 1914-28.

Season.	*Area. Feddans.* 000's.	*Crop. Kantars.* 000's.	*Average Yield per Feddan* (*Kantars*).	*Season's Average Prices.*		*Sudan Crop Kantars* 000's
				F. G. F. Brown. Pence per Lb.	*Premium over American Middling* (*per Cent.*).	
1914–15	1,755	6,490	3 70	7·34	40	95
1915–16	1,186	4,806	4·06	10 42	39	65
1916–17	1,656	5,111	3 10	21·56	75	92
				Sakel.		
1917–18	1,677	6,308	3·75	30·97	43	45
1918–19	1,316	4,821	3·66	27·85	41	64
1919–20	1,574	5,572	3·54	60·34	139	93
1920–21	1,828	6,030	3·30	30·24	154	122
1921–22	1,292	4,858	3·76	19·75	74	96
1922–23	1,801	6,213	3·45	17·29	16	113
1923–24	1,715	6,531	3·81	21·55	22	191
1924–25	1,788	7.274	4·07	29·82	116	180
1925–26	1,924	7,965	4·14	20·05	86	485
1926–27	1,786	8,635*	4·84	15·39	88	592
1927–28	1,516	6.097	4 02	19 39	74	504
1928–29	1,738	*7,500†*	*4·31*	—	—	646

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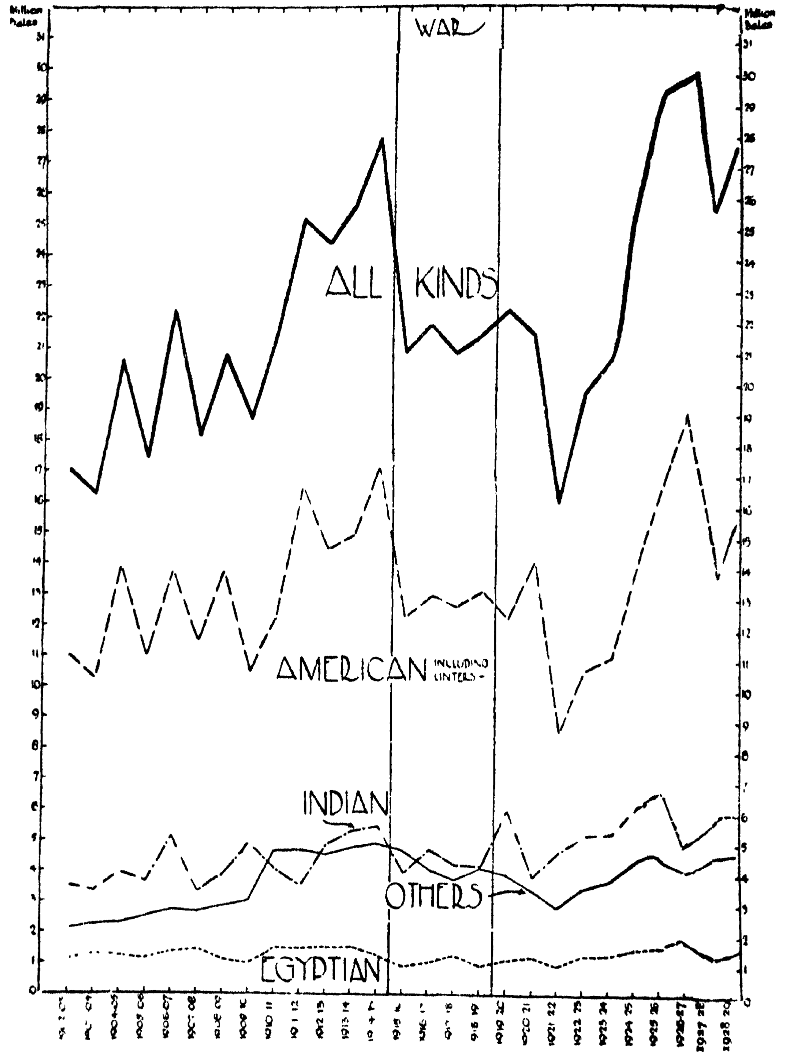
* The Government's final estimate was 7,652,190 kantars, the difference being the carry over up-country (see p. 169).

† A. G. P. A. November estimate.

THE WORLD'S COTTON CROPS 1902-28



NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

139. Report of the Work of the Indian Trade Commissioner during 1926-7 and 1927-8. By H. A. F. Lindsay. We have recently received a copy of this interesting Report, which deals, among other matters, with India's trade with the Continent, with the United Kingdom, and with North America.

The following statement gives details of purchases of Indian cotton by the Continent, in thousand bales, during each of the past three years:

	1925-6.	1926 7.	1927-8.
Italy	456	304	330
Belgium	243	159	230
Germany	218	145	237
France	193	123	185
Spain	73	54	62
Netherlands	47	30	36
Total	1,230	815	1,080

It is pointed out that with the exception of Germany, Indian trade with the Continent is in none too satisfactory a condition, and no efforts should be spared to widen Indian interest in these important markets.

140. Indian Central Cotton Committee. From the press communiqué of the eighteenth meeting held in December last, we learn that a long and interesting discussion arose on a report which summarized the results of eight investigations carried out in different cotton-growing tracts of India on how the cultivator finances and markets his crop. These investigations, which were made by the Agricultural Departments of the Provinces concerned from funds supplied by the Committee, relate to Khandesh, Berar, North and Middle Gujerat, Sind, the Punjab, and the Northerns and Westerns tract of Madras. The method employed in the investigations was to ascertain from each grower in selected villages typical of the tract, the source of his finance, the amount borrowed, the quantity of cotton produced, and the method of disposal. The local markets were also visited and full particulars of rates, customs, allowances, etc., obtained. The number of growers interrogated was 8,218, or an average of 1,027 per investigation, from 127 villages. Seventy markets were visited and 8,592 sellers examined. As these enquiries dealt only with the cotton crop, it is not claimed for them that they are complete economic studies, but they have provided a mass of information hitherto non-existent, and have helped to reverse several popular ideas. For example, they have shown that the generally accepted idea that the cultivator requires to borrow money to finance the harvesting and marketing of his crop is erroneous, as it has been found that borrowings are made practically only at sowing time. Again, it has been shown that the grower is not compelled by straitened circumstances or by pressure from the lender to sell his produce as soon as it is ready, for the majority of them often hold their crops up for considerable periods in anticipation of better prices, and early sales are effected not because of financial stringency but because of the fear of falling prices. The reports make certain recommendations regarding co-operative finance and sale, the need for certification and standardization of weights and scales, and the

desirability of establishing regulated markets in some of the areas investigated. No other study on a similar scale has been attempted in India, and the knowledge gained, especially in the marketing section, will be of great value to the Committee and to local Governments.

141. INDIAN CENTRAL COTTON COMMITTEE. (Abstr. from the *Ann. Rpt. for the year ended August* 31, 1928.) During the year under review much work has been done in connection with the Cotton Transport Act and Cotton Ginning and Pressing Factories Act, and considerable attention has been given to the question of cotton marketing and the prevention of abuses. The fumigation in Bombay of all American cotton arriving in India was continued in order to prevent the introduction of the Mexican boll weevil into the country. Under the heading of Research, it is stated that in addition to the Central Institute at Indore, the Committee is financing thirteen research schemes in the main cotton provinces of British India. Continued progress has been made in the research work that is being carried out at the Technological Laboratory under the direction of Mr. A. J. Turner.

142. REPORT ON THE CONDITIONS AND PROSPECTS OF BRITISH TRADE IN INDIA, 1927-28. By T. M. Ainscough. (Received from the Dept. of Overseas Trade.) Authorities are unanimous in the view that the improvement in economic conditions in India during the past year was most marked, and that the effects of the post-war trade depression are at last being dissipated. This has been due firstly, to improved economic conditions in the principal markets of the world, with the noteworthy exceptions of Russia and China; secondly, to the resulting stability in world prices, which appear to be at last finding a post-war position of equilibrium; thirdly, to the advantages accruing from the stabilization of the rupee; and lastly, to favourable conditions in the country itself. The monsoon for the sixth year in succession was a good one, and although floods caused considerable damage in Gujerat and certain districts in Bengal, crops in general were bountiful ones.

The exports of Indian merchandize showed a considerable increase with the exception of raw cotton. A decrease in the exports of the latter, amounting to 500,000 bales in quantity, was mainly due to reduced shipments to Japan, probably resulting from that country's financial difficulties during a part of the year, and also to the temporary substitution by Japanese spinners of large quantities of American cotton purchased at the end of 1926, when prices of middling American were abnormally low.

143. THE INDIAN AGRICULTURAL PROBLEM. By W. H. Moreland. (Abstr. from *Agr. J. of India*, xxiii., pt. v., p. 369, and pt. vi., p. 444, 1928.) A clear and well-thought-out discussion of the subject given under the following heads: The essence of the problem; Efficiency at the top; Ministerial control; The co-operative movement; Internal commerce and transport; The Central Government; The will to live better; Mass education; Mobilizing the intelligentsia; Supplementary considerations; Increase of rural income; The future.

144. INDIAN AGRICULTURE. By Albert and Gabrielle Howard. (Vol. viii. in *India of To-day* series. Reviewed in *Trop. Agriculture*, vi., 1, 1929.)

145. INDIA. *List of Cotton Pressing Factories with Names of Owners and Particulars of Marks Allotted to Them in the Different Provinces of British India and Certain Indian States for the Season* 1928-29. (Supplement to the *Indian Trade Journal*, December 6, 1928. Price As. 5 or 6d. Received from the Indian Central Cotton Committee.)

146. STATISTICAL INFORMATION CONCERNING COTTON SPINNING IN INDIA. (Cotton Yarn Assen. Ltd. Abstr. from *J. of Text. Inst.*, xx., 1, 1929, T. 10.) A useful statistical account of the spinning trade in India, giving numbers of employees required, hours of labour, wages, costs, etc.

147. INDIAN TEXTILE MILLS. VENTILATION. HUMIDIFICATION. By T. W. Johnstone. (*Ind. Text. J.*, 1928, 39, 18-24. Abstr. from *Summ. of Curr. Lit.*, viii., 26, 1928, M. 39.) The use of the kata thermometer for determining cooling powers, and regulations concerning the ventilation and humidification of mills are discussed. Whitewashing of shed roofs and windows, and roof spraying have been shown to be effective in reducing internal temperatures. The possibilities of improving conditions in weaving sheds by means of air movement alone have been explored by means of paddles on line shafts, flaps on heald rollers, fans on looms, gyro electric fans, and extraction fans. The relative advantages and disadvantages of each system are discussed. It is shown that while electric fans are probably ideal for improving conditions by air movement alone, the cost of such equipment is great. Tests have shown that there is no increase in warp breakages associated with increased air movement. Applications of the principle of evaporative cooling in Indian mills are described. Reports show that greatly improved conditions have been obtained in several mills by adopting systems in which cooled and humidified air is blown through ducts into the departments. Certain differences in construction between Indian and English mills necessitated by the differences in the two climates are discussed.

148. THE COTTON INDUSTRY IN AHMEDABAD. (Abstr. from the *Ann. Rpt. of the Millowners' Asscn., Ahmedabad*, 1927-28, recently received.) During the year the Association dealt with several important questions relating to the Rules and Regulations of the Cotton Merchants' Association, Humidification in Mills, Deductions from Wages in respect of Fines, Certain recommendations of the Indian Tariff Board, and the action taken by the millowners thereon.

149. REPORT UPON COTTON INVESTIGATIONS IN THE CENTRAL PROVINCES AND BERAR, 1927-28. By W. Youngman. This report contains an interesting description of manurial and rotation experiments that have been carried out at Akola Farm. Investigations are also being conducted into the water requirements of the cotton plant, and in connection with these a hydrometer method has been elaborated whereby water differences in the soil can be fairly rapidly estimated.

150. COTTON IN BOMBAY. (Abstr. from the *Ann. Rpt. of Dpt. of Agr., Bombay*, 1926-27 recently received.) It is stated that progress in the improvement of cotton has been made in every division during the year under review.

151. BOMBAY COTTON ANNUAL, 1927-28, No. 9. The usual authoritative compendium of all matters relating to every branch of the Cotton Trade. It is designed to meet the requirements of all who are interested in the production, distribution, and consumption of Indian cotton, and contains statistical tables of Crops, Exports, Imports, Prices, Stocks, Consumption, Government Notifications, etc.

152. COTTON CULTIVATION IN MADRAS. (Abstr. from the *Rpt. of the Operations of the Dpt. of Agr., Madras Presidency, for the Year* 1927-28, p. 75.) The main work with cotton consists of the distribution of the improved varieties evolved at the cotton-breeding stations, and the arrangement for supplies of pure seed. Demonstrations are also given showing improved methods of cultivation, such as drill sowing and intercultivation with cattle-drawn implements, as well as better methods of picking and co-operative ginning and marketing. There is a large and growing demand for seed of the new strains, and the difficulty of meeting it lies in the fact that the ryot is apt to lose his own seed by selling his produce as kapas. This is mixed in the ginneries, and seed obtained from that source is very apt to be mixed. To overcome this difficulty the Department has organized a

system of seed farms. Under this system selected ryots are given seed free of cost on the understanding that they will cultivate the cotton on the lines laid down by the Department, and keep it pure. At harvest, the Department either buys the kapas outright, gins it, sells the lint, and retains the seed, or alternatively, helps the ryots to gin their kapas co-operatively and sell the lint, and merely buys the seed from them. This latter method is the better, as the ryots themselves then get the benefits of market prices and such profit as there may be.

153. COTTON TRANSPORT ACT IN THE MADRAS PRESIDENCY. (Abstr. from *Digest* No. 75, 1928, of the Operations of the Dept. of Agr., Madras.) Changes have been made in the working of the Cotton Transport Act, and there will be only two protected areas in future: (i.) The Northerns and Westerns area, and (ii.) the Southerns area. Licence is not necessary in future for the import of cotton seed anywhere in the Madras Presidency, or for the movement of kapas, lint, and cotton waste between any two places in either of the two areas above specified.

154. THE ORIGIN, PLAN, AND PROGRESS OF THE SAKRAND AGRICULTURAL RESEARCH STATION, SIND. By H. H. Mann. (*Bull. No.* 145, Dpt. of Agr., Bombay, 1927.) The author states that in this bulletin he has endeavoured to give some idea of the agricultural conditions under which it is proposed to develop the land under the Sukkur barrage in Central Sind, and of some of the problems which *must* be settled before the development takes place, if the best results are to be obtained and disasters avoided. The Sakrand Agricultural Research Station is intended to experiment in connection with these problems, with a view to having the information at hand when the barrage water becomes available. At the station, barrage conditions can be reproduced now almost (though not quite) in their entirety, on land typical of enormous areas in the country, and there is reason to suppose that before the barrage water becomes available in four or five years' time it will be possible to determine how best the land should be opened out, what crops and rotations will give the best returns, how salt land can best be dealt with, what water will be needed by the crops grown, and how best it can be applied, what varieties of each crop will give the best results, and how the land coming under the barrage can be protected from deterioration and from diminution in the returns.

155. STUDIES IN THE JOWARS OF GUJARAT. I. THE JOWARS OF THE SURAT DISTRICT. By M. L. and C. B. Patel. (*Mems. of the Dept. of Agr. in India*, Bot. Ser., vol. xvi., No. 1, 1928.) In the Surat District sorghum, or *jowar*, is always rotated with cotton, and its sowing is generally delayed until the cotton has been planted.

156. HISTORY OF THE CALICO INDUSTRY OF INDIA. By Y. S. Thackeray. (*Anglo-Gujarati Qtrly. Jour. of the Ind. Merchants Chamber*, xxi., 3, 1929, p. 150.)

COTTON IN THE EMPIRE (EXCLUDING INDIA).

157. The following reports have recently been received:

Dept. of Scientific and Industrial Research. Rpt. for the year 1927-28.

BRITISH GUIANA: Rpt. of the Dept. of Science and Agriculture for the year 1927.

EAST AFRICA: Rpt. on the Trade and Commerce of East Africa to September, 1928 (C. Kemp).

FIJI: Ann. Rpt. of the Dept. of Agr., 1927.

GAMBIA: Ann. Rpt. of the Dept. of Agr. for the year 1927-28.

INDIA: Rpt. of the Millowners' Assn., Ahmedabad, 1927-28.

Rpt. of the Dpt. of Agr., Bombay, 1926 27.

Rpt. on the Conditions and Prospects of British Trade in India, 1927-28 (T. M. Ainscough).

Rpt. on the Work of the Indian Trade Commissioner during 1926-7 and 1927-8 (H. A. F. Lindsay).

Rpt. on the Operations of the Dept. of Agr., Madras, for the year 1927-28.

Sci. Rpts. of the Agr. Res. Inst., Pusa, 1927-28.

NYASALAND: Ann. Rpt. of the Dept. of Agr., 1927.

SUDAN: Ann. Rpt. of the Dept. of Agr. and Forests, 1927.

WEST INDIES: Rpt. on the Agr. Dept. St. Kitts-Nevis, 1927-28.

158. REPORTS FROM EXPERIMENT STATIONS, 1927 28. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d. post free.) In the preface to this volume we have called attention to the chief points of interest contained in it, and may refer to that for detail. Perhaps the most striking thing in the report, from the point of view of those looking for quick results, is the success so rapidly attained in breeding jassid-proof cottons suitable to South African conditions; but from a less spectacular point of view it may be said that the work as a whole represents a solid and valuable advance towards a solution of the great problem of making cotton a stable and profitable crop in as many different parts of the Empire as possible. When this problem is solved, a great advance will also have been made in the solution of the wider problem of how to make cotton a stable crop with a steady price. Much good work is described in this book, dealing with such subjects as the control of bollworm, the breeding of improved varieties of cotton, the shedding of cotton bolls, the improvement of methods of cultivation, etc.

159. AFRICA: EASTERN AFRICA TO-DAY. Compiled and edited by F. S. Joelson. (pubd. by *East Africa*, 1928.) This is a book of a kind which has long been wanted. It gives a description of every district in East Africa (colony by colony), written (usually) by someone long resident there. The descriptions include location, elevation, climate, cultivations, European element in the population, hotels, garages, etc. The whole book thus becomes an indispensable work of reference for anyone who has anything to do with East Africa, whether for trade, sport, settlement, or other purpose.

160. NIGERIA. The *Seventh Ann. Bull. of the Agr. Dept., Nigeria*, 1928, gives particulars of various experiments with cotton—including cultivation, manurial, varietal and selection tests, and experiments on growing cotton through yams—at Ilorin, Samaru, Kano, Sokoto, Yandev, and Maigana Seed Farm. Investigations were also conducted to test the exhaustibility of the crop.

It is stated in the Bulletin that as a result of the visit of Mr. Engledow a new scheme for organized seed distribution has been drawn up, the object of which is to maintain the quality of the American cotton produced in the Northern Provinces by supplying the farmers with fresh seed from selected strains every three or four years. This scheme is to come into operation this season, and the work of multiplying the selected strains will devolve on the Empire Cotton Growing Corporation's Seed Farm at Daudawa.

161. *Transport.* (Abstr. from *Times Trade Supplement*, February 5, 1929.) The new branch railway line from Zaria to Gusau (112½ miles) was opened to traffic on October 1, and is being extended to Kaura Namoda, a further 29½ miles. Construction is well in hand on another extension from Kano to Hadeija and N'guru, near the Northern border. A beginning has been made with the construction of a railway bridge across the Benue at Makurdi.

162. *The Cotton Industry.* (Abstr. from the *Half-yearly Rpt. to September* 30, 1928, recently received from the Director of Agriculture.) *Northern Provinces.*—The season appears to have been a favourable one; the rains started normally, and were well up to the average. The crop is estimated at 28,000 bales; 2¼d. per lb. is being offered for Grade I. seed cotton.

Southern Provinces.—The seed of the improved Ishan cotton has been sold at ½d. per lb., and sixteen tons of the available twenty were taken up, although ordinary native seed could be obtained free of charge. This is the result of the premium of 1d. per lb. paid last year on Ishan seed cotton.

Middle Belt.—A careful study is being made of the relative merits of different varieties of cotton for cultivation in the Middle Belt.

163. NYASALAND. *Cotton Cultivation*, 1927. (Abstr. from the *Ann. Rpt. of the Dept. of Agr.*, 1927, recently received.) The area under cotton with European management has decreased, but the success of the "Over-the-Top" varieties is causing renewed interest to be taken in this crop by planters. Native grown cotton has also fallen off, mainly through disappointment with the prices paid in the previous year.

The Empire Cotton Growing Corporation has now produced sufficient seed of "Over-the-Top" to allow of a serious start being made with the task of replacing "Nyasaland Upland" in areas in which "Over-the-Top" cotton has proved to be superior. One ton of seed of this variety was sent to Lisungwe, as this section was considered, owing to its isolation and to the interest taken by Chief Simon in cotton-growing, to be the most suitable for multiplication of a new variety on a commercial scale.

During the course of their cotton investigations, the officers of the Corporation have done much experimental work with rotation crops with a view to extending the list of crops grown in this country for export.

282·5 tons of cotton seed were distributed during the season.

Cotton Crop Prospects, 1928.—The cotton price fluctuations have been a severe stumbling block to natives in the past, and it has been imperative that efforts should be made to enlighten them in this matter; causes of price fluctuations have therefore been simply and carefully explained throughout the districts. The natives now appear to have grasped the arguments, and are showing renewed interest in the cotton industry. A big increase in production is confidently expected next season, despite the seed shortage and reduction in amount of seed to be issued to individuals.

164. NORTHERN RHODESIA. *Cotton Cultivation*. (Abstr. from *Rpt. on the Trade and Comr. of East Afr. to September*, 1928 [C. Kemp], recently received from the Dept. of Overseas Trade.) It is stated in this Report that although the cotton crop of Northern Rhodesia is practically negligible, it is not anticipated that cotton will go out of cultivation. It is valuable as an item in crop rotation, and what is most important to the Protectorate, it is a crop which if produced successfully can bear the relatively heavy charges of exportation overseas.

165. SOUTHERN RHODESIA. In his speech at the luncheon given in his honour by the British Cotton Growing Association in November last, Sir John Chancellor, late Governor of Southern Rhodesia, made the following reference to the work of the Corporation: "The Empire Cotton Growing Corporation have established an experimental station near Gatooma. They have working there two very clever young scientists, who are studying the cotton problem and trying to produce a strain of cotton that will resist the jassid, the most formidable of the local pests. They are making wonderful progress. When I visited the experimental station some months ago they showed me rows of cotton plants raised from the old seed and from the new strain which they are developing. The difference between the two was remarkable. The plants from the new seed were covered with well-developed bolls. The leaves of the plants from the old seed were diseased and discoloured, and the bolls were few in number and stunted.

"Mr. Cameron, the representative of the Empire Cotton Growing Corporation in Rhodesia, of whose work I cannot speak too highly, has the confidence and affection of every farmer in the Colony. He told me, and he is very careful in everything he says, that he hoped in a year's time to be able to distribute the improved cotton seed to the farmers, and so to introduce cotton again as an important crop. There will be no difficulty in inducing farmers to take up the cultivation of cotton again. His difficulty has been rather to hold them back until he could supply them with the new seed. Those who planted cotton three or four years ago found it to be a most valuable rotation crop, and that the yield of the maize crop that followed cotton was increased by three or four bags to the acre. As soon, therefore, as the new seed is available, the cultivation of cotton will go ahead again."

166. *Cotton in Southern Rhodesia. Propagation of U. 4 Seed.* By G. S. Cameron. (Abstr. from the *Rhod. Agr. Jour.*, xxv., **11**, 1928, p. 1225.) An article explaining the origin of U. 4 seed. This constitutes the first issue of seed by the Cotton Breeding Station, Gatooma, which is made in order to meet the urgent need of the Colony for a strain of jassid-resistant cotton that holds out some promise of an adequate return. The re-selection and bulking up of better strains is being actively pursued at the Station.

167. *Transport.* (Abstr from the *Sun and Agr. Jnl. of S. Afr*, December, 1928, p. 1159.) The first Road Motor Services in Southern Rhodesia which were introduced in 1927, were undertaken by the Railways in conjunction with the Government, and in many cases at their request. From the experience already gained it may be said that the services will considerably improve conditions in the outlying districts, and will tend to encourage various forms of agricultural production which were previously found to be unremunerative owing to the lack of efficient transport to the railways at a reasonable rate. The six wheeled lorry has been adopted as the standard unit for operating the Road Motor Services, since it is much better equipped to run over rough roads in adverse weather conditions than the more conventional four wheeled motor vehicle. There are now fifteen motor services in operation, and the opening up of further districts is under consideration.

168. SOUTH AFRICA. *Cotton Cultivation.* (Abstr. from *Farming in S. Afr.*, iii., **32**, 1928.) From the Annual Report of the Dpt. of Agriculture for the year ended June 30, 1928, we abstract the following information: "Owing to drought, the promise of the 1927-28 cotton crop has not been fulfilled. The crop is now estimated at 9,816 statistical bales, an increase of approximately 20 per cent. over the previous year. Prices fortunately have improved on last year.

"The most serious drawbacks to cotton cultivation are the bollworm and jassid. In spite of every effort on the part of entomologists, no effective remedy against the red bollworm has yet been found. The cultivation of cotton has been so beset with difficulty that the number of growers has decreased to about 40 per cent. of what it was three years ago. New hope, however, has come to the growers; new types of cotton have been bred, particularly jassid-resistant varieties. Mr. Parnell, of the Empire Cotton Growing Corporation, has selected plants at the Barberton Experiment Station which seem to provide hope for solving the serious problem of the jassid pest. During the past three years this work has been continued with remarkable success, and to-day the U.4 and Z.1 selections appear to have solved the problem for good. The U.4 plants carry a large number of small bolls, and this fact may to some extent assist in the solution of the bollworm problem. It is noticed that the bollworm confines its attack principally to one or two bolls, hence the proportion of undamaged bolls remains relatively large, with the result that in spite of severe attack a good yield is obtained.

"The Empire Cotton Growing Corporation, under Mr. Milligan, is extending its experimental work materially, and the assistance given to the industry is greatly appreciated.

"The breeding and selection work that is being carried out at Rustenburg is progressing satisfactorily, and a good type of Improved Bancroft suitable to middle-veld conditions is being widely distributed.

"The grading carried out by the Divisional officers at Durban has been satisfactorily performed, and no complaints have been received from overseas."

169. COTTON GROWING IN SWAZILAND. (Abstr. from *South Africa*, January 1, 1929.) In the course of his report as managing director of the Swaziland Corporation (1924), Mr. Allister M. Miller, reviewing the results of cotton-planting on the Company's estate, writes: "The last four years have been a period of experiment. We started with Griffin, which was then the best seed available, and subsequently tested Improved Bancroft, which proved less productive. Uganda was first tried in the 1925-26 season, and in the 1926-27 season was almost wholly planted in preference to Griffin and Bancroft. In the 1927-28 season it was planted as the main crop; jassid-resistant seed then available being sufficient only to lay down sixty-one acres. For the 1928-29 season, Uganda will be discarded, as we are fortunate in having obtained enough Z.1 bulk and Z.1 re-selected to plant 600 acres, and give us a small surplus for replanting should it be necessary. In addition, the Empire Cotton Growing Corporation has allotted us sufficient U.4 seed to hand-plant forty acres, of which 8¼ acres will be under irrigation. Under reasonable climatic conditions, this will give us for future operations enough U.4 seed to reject Z.1 bulk and Z.1 re-selected, and concentrate on this heavy yielder. It took Sudan Plantations ten years to find a suitable seed for soil and climatic conditions, but the Empire Cotton Growing Corporation's research work appears to have accomplished reliable results in less than half that time.

"Our four years' work has proved that cotton can be grown on our land, commanding a good price in the Liverpool market, from indifferent seed and under varying climatic conditions. We have raised during this period of testing out varieties upwards of 139,810 lb. of lint, which has returned us about £6,496 (thirty-four bales of this season's crops have not yet been realized), and the average price over a period of fluctuating markets has been 11·14d. per lb. It remains only to increase the yield per acre by the selective work which the Empire Cotton Growing Corporation is doing, and we believe they have already gone far in that direction in the introduction of U.4."

170. SUDAN. From the *Ann. Rpt. of the Dept. of Agr. and Forests*, 1927, recently received, we learn that during the year under review there was an excellent output of cotton from the Gezira Scheme, a good output from the Gash Delta, and a fair output from Tokar, Berber, and Dongola, and from southern rain land. The two new ginneries at Talodi and Kadugli were completed. The chief pests and diseases causing damage to cotton were the Sudan Bollworm, Egyptian Bollworm, Pink Bollworm, Locusts, Blackarm disease and Sooty Mould disease.

171. COTTON GROWING IN THE SUDAN. In his speech at the luncheon given in his honour by the British Cotton Growing Association in October last, Sir John Maffey, Governor-General of the Sudan, stated that in the present season the area under cotton in the Gezira had been increased from 105,000 to 131,000 feddans, and—looking still further ahead—in 1930 there should be 170,000 feddans under cotton.

Dealing with American cotton in the Sudan, Sir John said that the yield of rain-grown cotton (in which Lancashire is more especially interested) had remained stationary at 20,000 kantars. In 1926 they had promised to produce 50,000 kantars of rain grown cotton, but owing to two years of drought they had failed to do so, since the people had to turn their attention to growing food. With the approach, however, of more normal weather conditions with better rains, it was hoped that the area under rain-grown cotton would steadily increase.

172. *Cotton Prospects.* The latest report received from the Commercial Intelligence Branch of the Central Economic Board is to the effect that the condition of the cotton crop is good.

173. TANGANYIKA. *Cotton Prospects.* (Abstr. from *Rpt. on the Trade and Comr. of East Afr. to September,* 1928 [C. Kemp], recently received from the Dept. of Overseas Trade.) In the Mwanza Province late and varying rains have affected the cotton crop very badly, but in the Central Line there has been a very great increase in production. Renewed interest in inter-planted cotton on non-native estates in the Central districts seems to have contributed something towards the better results expected from that area, but owing to two or three bad seasons, anxiety is felt regarding the future of cotton cultivation in the Mwanza Province.

174. *Agricultural and Industrial Exhibition,* 1929. We have received notification that the period of this Exhibition will be from the 2nd September to the 6th September, 1929.

[*Cf.* Abstract 24, p. 70.]

175. UGANDA. *Cotton Prospects.* The latest report on the cotton crop is to the effect that good yields are expected from most districts.

176. *Cotton Cultivation,* 1927-28. (Abstr. from *Rpt. on the Trade and Comr. of East Afr. to September,* 1928 [C. Kemp] recently received from the Dept. of Overseas Trade.) It is estimated that the 1927-28 cotton crop will reach just over 140,000 bales. The increase in production in the Buganda Province should, under normal conditions, have assisted in securing a much larger total figure, but it, unfortunately, did little more than compensate for the fall in the estimated crop of the Eastern Province following abnormal drought conditions, which affected not only the cotton crop, but also the food crops, with the result that a fairly general state of famine prevailed in that Province. With the extension of the railway to Jinja much of the Eastern Province crop was transported by rail instead of by lake steamer, and with the decision that has been reached to extend the line further to Kampala, little more should be heard of delays in getting the cotton crop of Uganda away owing to congestion at lake ports.

The more intensive cultivation of cotton and the increased demand for seed for the 1928-29 season has given rise to early forecasts that the next crop will be at least 200,000 bales.

The outstanding features of the past season have been the operations of the Buganda Cotton Buying Association, and the extent to which ginneries have changed hands.

177. AUSTRALASIA: COTTON GROWING IN QUEENSLAND. (Abstr. from *Queensland Agr. Jnl.,* xxx., 5, 1928, p. 458.) From the summary we extract the following: " Excellent yields of cotton can be produced over a large area of country. The favoured cotton-growing country lies between the coastal and the Main Dividing Ranges, and the valuation of much of this land is low in comparison with that of the more closely settled coastal areas. A considerable area of Crown land is also available in the districts suitable for cotton-growing. Owing to the distance of these areas from markets for perishable produce, dairying appears to be the most suitable of the older established industries. Cotton-growing combines excellently with the dairying industry—the cultivation period of the former occurring at such a time as to permit both industries to be practised in conjunction. An attractive feature is that the returns from cotton-growing are received during the period when dairy production is at its minimum. The implements necessary for cotton production can also be used in the production of maize or fodder crops, and by a combination of cotton-growing with these industries the overhead expenses are distributed."

178. Fiji. *Cotton Cultivation*, 1927. (Abstr. from the *Ann. Rpt. of the Dpt. of Agr.*, 1927, recently received.) The report by Mr. Anson, the Cotton Specialist, describes the selection work carried out with Sea Island and New Guinea Kidney cottons, varietal experiments with Korolevu Hybrid, Meade, and Pima cottons, and spacing and time of flowering experiments. The chief pests encountered during the season were: Pink Bollworm, Cotton Stainers (*Dysdercus insularis*), Harlequin (or Tectocoris) Bug; Leaf Hopper, Tip Worm, and Fruit fly (*Dacus passifloræ*), which was found on Meade and Kidney cottons, but was not discovered on Sea Island.

179. WEST INDIES: Nevis. *Cotton Cultivation*, 1927-28. (Abstr. from *Rpt. on the Agr. Dpt. St. Kitts-Nevis*, 1927-28, p. 21.) The acreage planted to cotton during the season was 876 acres, of which some 540 acres were grown by the small growers. Germination was good, but the cotton suffered severely from heavy rains. With the advent, however, of more favourable weather later the crop made good progress. Injury from cotton pests and diseases during the season was negligible.

180. Cotton Cultivation in St. Vincent. From a report, recently received, on the cotton crop for the quarter ended December 31 last, we learn that severe attacks of cotton caterpillars (*Alabama argillacea*) were experienced, and soft rot of bolls was responsible for very considerable losses. It is expected that late planted cotton will give a fair return if Pink Bollworm does not breed up rapidly.

COTTON IN EGYPT.

181. Some Recent Activities of the Cotton Research Board of Egypt. By Arno S. Pearse. (Abstr. from *Int. Cot. Bull.*, vii., 26, 1929, p. 309.) "Out of a number of new varieties the Botanical Section of the Ministry of Agriculture is concentrating on three extremely promising strains—viz., Giza 7, Giza 3, and Sakha 4. These new varieties have been tested on the 14 checker plots (small experiment stations) which the Section arranges all along from the northern part of the Delta to Upper Egypt, south of the Assiut, covering 600 miles of latitude.

"The halo lengths of these cottons are:—

Giza 3 ..	32 mm.	As compared with ordinary Uppers of 29 mm.
Giza 7 ..	34 mm. in Upper Egypt	
Giza 7 ..	35 mm in the Delta	
Sakha 4 ..	38 mm., as compared with Domains Sakel 36 mm.	

"It must be noted that halo length does not correspond to staple length, the latter being on an average 2 mm. longer.

"Whilst until quite recently Upper Egypt was not considered suitable for long-staple cottons, the experiments undertaken by the Botanical Section have proved conclusively that these strains, at all events, give excellent yields in Upper Egypt, even in the extreme south. It may, therefore, be claimed that we are witnessing an evolution in Egyptian cotton-growing which was never deemed feasible, and that, at all events, Giza 7 will be grown at a cost that will be equal to Uppers. As regards the quality of Giza 7, the Government grader has even put it as being above 310, when grown in especially suitable localities. Besides the high yield per acre (50 per cent. to 25 per cent. higher than Sakel), it has a high ginning outturn.

"In 1929 there will be 500 feddans grown of this cotton, and by means of intensive use of every seed it is expected that by 1930 5,000 feddans will be grown."

182. THE INDUSTRIAL STATUS OF EGYPTIAN COTTON. By Dr. W. L. Balls. (Abstr. from the *Morning Post*, January 5, 1929.) Discusses the competition from artificial silk, and from other cotton-growing countries.

183. COTTON IN EGYPT. THE PLANT BREEDER'S TASK. By C. H. Brown. (Abstr. from the *Morning Post*, January 5, 1929.) The author states that a better stapled, higher yielding cotton with a Sakel lint is needed for Upper Egypt, and a cotton for the south of the Delta which will command universal favour, instead of the present mixture of varieties found there. The cottons to supply these needs all now exist in the two new types Giza 3 and Giza 7, and Maarad cotton. Nothing remains but to propagate them.

184. NOTES MADE ON A TOUR IN EGYPT. By Sir Thomas Middleton, H. C. Calvert, and N. Gangulee. (Abstr. from the *Agr. J. of India*, xxiii., pt. vi., 1928, p. 413.) During the tour visits were made to the Guimeza Experimental Farm and to the extensive properties of the State Domains Administration. The State farm at Guimeza undertakes the task of growing new varieties of cotton raised by the Botanical Department of the Ministry of Agriculture, Giza, and of thoroughly testing them; the best strains will then be multiplied on the farms of the State Domains for general distribution.

185. STANDARDIZED COTTON TARE IN EGYPT. By W. I. Holt. (*Circ. No.* 47, 1928, U.S. Dept. of Agr., Washington, D.C.) A study of the Egyptian methods of baling and marketing cotton, made in the hope that it will suggest practical methods for improving the American bale. The pamphlet is well illustrated.

COTTON IN THE UNITED STATES.

186. CALIFORNIA. COTTON PRODUCTION. (Abstr. from *Southern California Crops*, vol. iv., No. 11, 1928, issued by the Agr. Dpt. Los Angeles Cham. of Com.) The climate of the year has been favourable, and the California cotton crop is estimated at 147,000 bales. There is a scarcity of pickers in most sections.

187. REPORT ON THE 1928 JOURNEY THROUGH U.S.A. By Arno S. Pearse. (Abstr. from *Int. Cot. Bull.*, vii., **25**, 1928.) The first section of the report deals with the American cotton mill industry, and the second refers to all matters relating to the raw material, such as crop conditions, Government forecasts, standards for length of staple, co-operative farmers' associations, and machine methods of harvesting. At the commencement of the report a very interesting account is given of the advances in mass-production that have been made in recent years, and in view of the great competition to which this seems likely to lead, it is well worth study by workers in other countries. The attitude of the American trades unions to high output is also described.

188. REGULATIONS OF THE SECRETARY OF AGRICULTURE UNDER THE UNITED STATES COTTON STANDARDS ACT. (*U.S. Dpt. Agr. Serv. and Regulatory Announcements No.* 115, *Agr. Economics*, 1928.) These Regulations (effective on October 1, 1928) have to do with the following: Definitions; Administrative and general; Requests for classification and comparison; Submission and disposition of sample for Form A and Form B determinations; Submission of cotton, supervision and sampling, in Form C determinations; Classification; Sample or type comparison; Certificates and memoranda, Forms A, B and C; Reviews and appeals; Supervision of transfers of cotton; Licensed classifiers; Official cotton standards; Fees and costs; American cotton linters; Adjustment of disputes arising from contracts for the shipment of cotton from the United States; Publications.

189. BALED COTTON IN THE U.S.A.: MOISTURE CONTENT. (Text. Operative Executives, Georgia. *Cotton* [*U.S.*], 1928, **92**. Abstr. from *J. of Text. Inst.*

xix., 12, 1928, A. 410.) A report of a discussion of the moisture content of freshly-opened cotton. Examples of variations observed in practice are given, ranging from 5¼ to 24 per cent. Reference is made to tests of the moisture content of cotton as received at the French ports, carried out by the French Society of Spinners. Their figures indicate that the moisture in cotton is largely determined by the weather prevailing during the ginning season. Charts are given showing rate of regain in a room at constant humidity and change of moisture in laps, with change in atmospheric humidity. Difficulties experienced in drying certain types of cotton are mentioned, and it is suggested that this may be caused by the type of soil in which the cotton is grown.

190. EXCESSIVE MOISTURE IN AMERICAN COTTON. (Abstr. from *Int. Coll. Bull.*, vii., **26**, 1929, p. 307.) Recently spinners of American cotton in England have complained bitterly of an unusual amount of moisture in shipments of American cotton, especially in Boweds, which was causing inconvenience and difficulty in working, and subjecting many of them to financial loss. Representations on the matter, with a view to securing redress of the grievance, have been made by the English Federation to the Dept. of Agriculture, Washington, the American Cotton Growers' Exchange, the American Cotton Shippers' Association, and to other quarters.

191. COTTON GRADING. U.S.A. By C. H. Pease. (*Text. World*, 1928, **74**. Abstr. from *Summ. of Curr. Lit.*, viii., **27**, 1929, L. 65.) The cotton grade and staple surveys that are being conducted by the Division of Cotton Marketing of the Department of Agriculture, are part of a broad plan of statistical and scientific research. The plan is educational for both spinners and growers. It will define cotton and its characteristics, including spinning qualities, in terms easily comprehensible to all factors of the trade. It will provide census of production, carry-over, and consumption by grade and staple figures which will be a guide to supply and demand trends for both grower and spinner. Figures so far collected appear to indicate that American farmers are producing a surplus of staples under ⅞ inch, whilst the medium and long staples are relatively scarce.

192. AMERICAN COTTON. PRICES By E. Schultze (*Leipziger Monats., Text.-Ind.*, 1928, Fachheft 3, 110 3. Abstr. from *Summ. of Curr. Lit*, viii., **26**, 1928, M. 38) American cotton prices since the middle of the nineteenth century are reviewed, and the causes of price fluctuations and need for reliable crop estimates are discussed.

193. THE AMERICAN COTTON MILL INDUSTRY By H. Windfeld-Hansen. (*Int. Cot. Bull.*, vii., **25**, 1928)

194. RELATION OF FARM PRICES TO QUALITY OF COTTON. By G. L. Crawford and L. P. Gabbard. (Abstr. from *Bull.* 383, Texas Agr. Exp. Sta., 1928.) From the summary we extract the following. "The primary object of this study is to determine the degree to which the local markets discriminate between the different grades and staples of cotton, and to show the extent to which central market values are reflected in the prices received by cotton-growers.

"A tabulation of monthly averages of local prices according to grade shows some effort on the part of the local trade to follow grade, but not a consistent effort. Illustrations from the sale of individual bales of the same staple length for the same date revealed the fact that a given grade quite frequently sold for less than the next lower grade. In a study of the spread between local prices and central market values grouped according to grade, regardless of staple, it was quite evident that the low grades had been recognized and penalized. The higher grades seemed to have been bought on a flat basis, thus being automatically penalized.

"In the case of staple, there was no evidence of a conscious effort on the part of the local trade to reward long staple and penalize short staple. Each point seems to have had a staple rating, and all cotton regardless of staple length bought on that basis. Such a practice fails to penalize cotton of short staple, and to adequately reward cotton of long staple. This was evident in a study of the spread between local prices and central market values on the basis of staple. Thus it is seen that the great bulk of cotton is bought from the farmer, not on a quality basis, but on an *average* basis, and particularly so in regard to staple.

"It is quite generally recognized that this method of local buying is encouraging the farmers to plant varieties that will give them the highest yields regardless of staple. It has been estimated that of the fifteen million bushels or more of cotton seed planted in Texas during the spring of 1927, more than ten million bushels were gin-run seed, more than four and one-half million bushels were somewhat improved, and less than one-half million bushels were pedigreed seed. It is evident that the farmer who plants low quality varieties tends to reduce the average of the quality or spinning utility of the cotton of his community. However, under the method of buying 'point cotton,' the grower who grows cotton of high quality is penalized for his efforts to hold the average of the community high. In effect, he is paying his neighbour who grows the poor-quality cotton a premium.

"The responsibility for the solution of this problem cannot be placed upon any one group. It is one in which the full co-operation of growers, spinners, ginners, breeders, the cotton trade, and agricultural workers is required. Agricultural Experiment Stations in the cotton belt have done much to test and develop cotton varieties in an effort to keep the quality of cotton high. Cotton breeders have a constructive programme of improvement, but all of these efforts fall far short of their possible application because the farmers' market fails to properly recognize and adequately reward a quality product."

COTTON IN FOREIGN COUNTRIES.

195. CHINA: REPORT ON THE COMMERCIAL, INDUSTRIAL, AND ECONOMIC SITUATION IN CHINA TO SEPTEMBER 1, 1928. By H. H. Fox. (Recently received from the Dept. of Overseas Trade.) The year has been a depressing one for the cotton mills (p. 37), though the export of raw cotton continues to increase (p. 59).

196. COTTON MILL ECONOMICS IN CHINA. (*Cotton* [U.S.], 1928, **92.** Abstr. from *J. of Text. Inst.*, xix., **12**, 1928, A. 437.) A study of Chinese customs and practices, and comparisons with methods and results obtained in Lancashire mills. Difficulties of language, climatic conditions, and inefficiency of operatives are discussed. It is shown that, although wages are low, the labour costs per pound of yarn spun are not so low as is often imagined from the wage figures. Owing to the inefficiency of operatives, hours are long (twelve per shift) and staffs large.

197. COTTON GOODS. CHINA (SHANGHAI). MANUFACTURE. By H. F. Wilkins. (*Ind. Text. J.*, 1928, **38**, 373-76. Abstr. from *Summ. of Curr. Lit.*, viii., **22**, 1928, M. 33.) Shanghai is the centre of the cotton industry in China. Most of the cotton manufactured is grown in China. Shensi cotton is regarded as the best, and is about ⅞ inch long. The cultivation, gathering and transportation are described. Cotton is bought by name, not by grade or staple. Samples are not usually given, and adulteration is prevalent. Cotton mill operation, mills and machinery, the staffing problem, costs of production and profits are discussed. Although wages are low and the working hours long and hard, the individual efficiency of Chinese workers is low, and in order to conform with accepted Chinese custom, millowners have to pay various bonuses and gratuities. The Japanese own the greatest number of mills in Shanghai, and have nearly five times as much capital invested in the cotton industry as the Chinese. There are two large British companies manufacturing cotton goods in Shanghai. Labour unions among the cotton workers are well organized, and have large memberships. In August, 1927, there were seven big strikes. Chinese and Japanese Millowners' Associations have been formed, and also a Joint Committee of Shanghai Cotton Millowners, with Chinese, Japanese, and British representatives The Cotton Anti-adulteration Association was organized in 1901, and consists largely of British and Japanese members It maintains a testing house and charges for testing according to bulk.

198. We have received from the Association Cotonnière Coloniale copies of Bulletins Nos 84, 1928, and 85, 1929, containing interesting information regarding cotton cultivation in the French Colonies

199. JAPAN JAPANESE MILLS (Abstr from *Text Rec*, xlvi, **549**, 1928, p 85) Latest reports from Japan show that of the 6,270,000 spindles in the trade, only about 4,700,000 are working, as a result of restriction agreed upon by the members of the Japan Spinners Association It has now been decided to extend the restriction to June 30, 1929, with special exemption applied to those mills which abolish night work prior to that date At that date night work in Japanese mills ceases by law

200. RUSSIA COTTON CULTIVATION We have received a copy of *Khlopkovoye Dielo*, No 9 10, 1928 The list of contents which is given in English, includes the following papers (in Russian) Rationalization and Intensification of Cotton-growing, by G V Shulimof, Some Data on the Culture of the Egyptian Cotton Plant in Turkmenia, by I Pobelhansky, Physico mechanical and Chemical Quality Characteristics of Russian Cotton, by V S Klubof and A A Erofeef, System of Methods in Selecting Average Cotton Samples and Cotton Defects in Samples for Laboratory Work, by A F Kalmikof and V S Shumkof

201. LA CULTURE DU COTONNIER EN ESPAGNE By L L Ortiz (Abstr from *Coton et Cult Coton*, iii, **2**, 1928, p 115) One of the best accounts we have read of the progress of cotton cultivation in Spain

CULTIVATION AND MACHINERY IRRIGATION, ETC

202. SOIL PROFILE IN THE EASTERN GEZIRA By H Greene (*J of Agr Sci*, xviii, pt iii, **26**, July, 1928) The distribution of salts in the soil is generally related to compactness of the soil profile as judged by the distribution of gypsum, of calcium carbonate aggregates, and of soil colour The relation already established between salt content and fertility is now expressed as a relation between compactness of profile and fertility The data agree well with geological views as to the origin of this soil Influences of which the soil profile is the product are also discussed

203. TRACTOR FARMING (Abstr from the *Sun and Agr J of South Afr*, September, 1928, p 890) It is stated in this article that a recent innovation in the general Farmall tractor of the International Harvester Company is proving a particular boon to farmers This tractor not only supplies an abundance of power for ploughing, listing discing, culti packing harrowing, harvesting, etc, the same as any other good tractor, but it is so constructed that it supplies power also to planting and cultivating, operations which hitherto have helped to create a lot of extra work on numerous farms at a time when so many important things must be done With the Farmall cultivation can be done more quickly and more thoroughly, and more time made available for other work

In construction, the Farmall differs quite radically in certain respects from other tractors. Its rear axle is built high with a clearance of 30 inches above the ground, and the rear drive wheels, which are 42 inches in diameter, are wide apart (74 inches between centres of wheels). This means that the axle is high enough to clear mealie or cotton as well as is done by the ordinary riding cultivator, and the wheels are far enough apart to straddle two rows and thus cultivate two rows at a time. The cultivator, moreover, is placed in front where the operator can carefully watch his work, and is guided by the steering wheel. The front wheels, which are 23 inches in diameter, are close together, and run between the rows. The Farmall tractor is making it possible for many a farmer to operate entirely without oxen.

Among the outstanding advantages of the tractor is the fact that it makes for better, cheaper and faster work. A three-plough tractor, for example, will plough ten acres in a ten-hour day, whereas two to three acres is good work for an ox-drawn three-furrow plough.

204. THE EFFECT OF THE SPACING OF COTTON UPON THE FORM AND HEIGHT OF THE PLANT. By W. E. Hinds. (Abstr. from *J. of Econ. Ent.*, xxi., **5**, 1928, p. 741.) This paper reports results of cotton growth on Mississippi River Bottom soil at the Louisiana Experiment Station, Baton Rouge, Louisiana. In 1924, with a total rainfall of 7·15 inches during June, July, and August, Salisbury cotton averaged 1,588 lbs. seed cotton per acre. The same variety on similar soil in 1925, with a normal rainfall amounting to 14·48 inches during June, July, and August, produced an exceedingly rank weed growth with abundant blooming, but practically complete shedding of small bolls, and no crop was picked.

Spacing tests were conducted in 1926 with Lone Star No. 65 cotton on similar soil, planted June 25, and records completed by September 25. Rainfall during June, July, and August amounted to 25·51 inches, and a severe tropical storm occurred on August 25, when over 10 inches of rain fell. The widest spacing—single plants 24 inches apart—produced invariably the lowest and broadest growth, with thickened bases to the stalks, heavy vegetative branches and delayed setting of bolls. The unthinned cotton was extremely slender and whip-like, with no vegetative branches and very few bolls. In all spacings varying from single stalks at 8 inches to from three to five stalks per hill, there developed a practically full stand of from 16,000 to 18,000 stalks per acre having " normal growth " and fruiting. These stalks were, as a rule, moderately slender, with few if any vegetative branches, and reaching a rather uniform height of 38 to 42 inches at three months of age. Hill spacing with three to five stalks at 12 to 15 inches apart appeared to give the most practicable and desirable spacing.

205. EXPERIMENTS WITH THE NUTRITION AREA OF COTTON PLANTS IN 1925-26. By N. T. Dierovitzky and I. Y. Staroselsky. (In Russian.) (Abstr. from *Works of Azerbayjan's Cent. Agr. Exp. and Plant-Breeding Station*, ii., 1927, recently received.) English summaries are given to each chapter. The authors state that as the result of two years' experiments they are convinced that with the increase of density (of planting) the ripening of the cotton plant is accelerated. Details are given of the effect upon fruiting and other activities caused by increase of density; size, weight, and number of bolls per plant all diminish.

206. COTTON FERTILIZER EXPERIMENTS. By C. B. Anders and W. W. Hull. (Abstr. from *Bull.* 250, *Miss. Agr. Exp. Sta.*, 1928.) *Summary:* In a complete mixture the greatest net profits are obtained where the amount of nitrogen equals or very nearly equals the amount of phosphoric acid used.

Potash is needed where rust is present and on many other soils. Four per cent. should be used on these soils. Superphosphate (acid phosphate) is recommended as the source of phosphoric acid.

The readily soluble forms of nitrogen, such as nitrate of soda, ammonium sulphate, leunasalpeter, calcium nitrate, and urea are highly efficient, and about equally effective as sources of nitrogen. Calcium cyanamid, as used in these tests, has not been satisfactory. Kainit, muriate, sulphate and trona are all efficient potash carriers.

Ammophos 20-20 was not as efficient as a source of phosphoric acid and nitrogen as a mixture of superphosphate (acid phosphate) and nitrate of soda. Nitropo was about as efficient as a source of nitrogen and potash as a mixture of nitrate of soda and muriate of potash.

In a one-season test, 150 lbs. of nitrophoska (32-16-16) was about as efficient as 600 lb. of an 8-4-4 composed of superphosphate, nitrate of soda, and muriate of potash.

207. MIXED NITROGEN CARRIERS. (Abstr. from *Fortieth Ann. Rpt. Exp. Sta., Ga.*, 1927, p. 12.) A new experiment was started in which different mixtures of organic nitrogen and inorganic nitrogen were compared. The first year's results were as follows:

Mixture.	*Seed Cotton (Lbs. per Acre.)*
50 per cent. cottonseed meal 50 per cent. sodium nitrate	941
35 per cent. cottonseed meal 65 per cent. sodium nitrate	1,000
20 per cent. cottonseed meal 80 per cent. sodium nitrate	1,117
10 per cent. cottonseed meal 90 per cent. sodium nitrate	1,061
100 per cent. sodium nitrate	993
No nitrogen	896

As far as can be concluded from the results of one year, it pays to mix a small amount of cottonseed meal with sodium nitrate for cotton. This practice will also greatly improve the mechanical condition of the fertilizer.

208. ABSORPTION OF NITROGEN BY COTTON PLANTS (Abstr. from *Fortieth Ann. Rpt. Exp. Sta., Ga.*, 1927, recently received.) Cotton plants were grown in a solution containing a mixture of ammonia and nitrate nitrogen. For the first two weeks the seedlings absorbed the nitrogen at the rate of 35 parts ammonia nitrogen to 100 parts nitrate nitrogen. This ratio of nitrogen absorption gradually changed until it was about 55 parts of ammonia nitrogen to 100 parts of nitrate nitrogen when the plants were six weeks old. Cotton plants did not grow in a solution containing ammonium acetate or potassium nitrite. Cotton seedlings grew better in solutions containing only nitrate nitrogen than in a solution containing only urea nitrogen.

209. EFFECT OF FERTILIZERS ON COTTON YIELD. (*Jour. of Amer. Soc. Agron.*, **20**, 1048. Abstr. from *Trop. Agriculture*, v., **12**, 1928, p. 328.) A study of the influence of various fertilizers on cotton yields shows that the yield may be increased by the influence of the fertilizers on at least three distinct factors. Firstly, the fertilizer may increase the number of bolls per acre without affecting the average size of the individual cotton bolls. Secondly, the size of the bolls and the number of bolls per acre may be increased. Thirdly, the size of the bolls and the percentage of lint per boll may be increased. Assuming the quality of the fibre to remain constant, the last method of increasing the yield should be the most profitable.

Addition of a nitrogen-phosphate fertilizer increased the total yield of cotton by 20 per cent. There was an increase of 22.6 per cent. in the number of bolls per acre. The bolls were slightly less in size than those on the control plot, and the percentage of lint per boll increased only slightly. The increased yield was therefore entirely due to the increase in the number of bolls per acre. Fertilizing with phosphate and potassium gave an increase of 10 per cent. in the total yield. The number of bolls per acre, however, had decreased, and the

EMPIRE COTTON GROWING CORPORATION

An increase in the number of sources of supply of raw cotton is a matter of the most urgent importance; it is hoped, therefore, that all those interested will aid the Corporation in their endeavours to extend the cultivation of cotton within the British Empire. They can assist in this direction by making the work of the Corporation as widely known as possible, and for this purpose it is hoped that subscribers for the Journal will be forthcoming from all cotton growing parts of the Empire.

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increased yield was due to a 13 per cent. increase in the size of the bolls and a 5·3 per cent. increase in the percentage of lint. Nitrogen-potassium treatment increased the number of bolls only by a small amount. The great increase in total yield was accounted for by a large increase in the size of the bolls and in the percentage of lint per boll. The last applications, therefore, gave the most satisfactory results.

210. RECENT FERTILIZER EXPERIMENTS WITH COTTON. By H. M. Steece. (Reprinted from *Rpt. on the Agr. Exp. Stations*, 1927, U.S.A.; Summary, published 1928.) Appropriate applications of fertilizers for cotton are required in order to provide economically for the current needs of the crop, and to compensate for the nutrients removed from the land in the seed and lint, and lost through leaching, reversion, and denitrification. From the experiments and recommendations cited it appears that nitrogen and phosphorus are in greatest demand in cotton production. Potassium appears to be decidedly secondary in importance, except under certain conditions, although its functions are recognized and its omission from the formulas is not generally advised.

Nitrogen in such readily available forms as sodium nitrate seems to be most desirable, although organic sources, including cottonseed meal and other vegetable meals, dried blood, and tankage, have the longer residual effect. Most of the recommendations have been based on sodium nitrate, yet ammonium sulphate and combinations with the nitrogen from two or more sources have also given good results. Some of the newer sources of nitrogen—*e.g.*, ammonium nitrate, ammonium phosphate, and ammonium chloride—have compared favourably with sodium nitrate and ammonium sulphate for cotton. From 100 to 300 lbs. of sodium nitrate per acre has been recommended, but the greater margin of profits seemed to be obtained with the lower rates. Experimental results in general suggest applying half of the sodium nitrate at planting and half at the first squares, or else making the whole application at some time between chopping and the appearance of the first squares.

Superphosphate has been preferred to other phosphorus carriers, and while the optimum application rates have varied with conditions, about 200 to 300 lbs. per acre seems to be a practical quantity. Potassium chloride, potassium sulphate, and kainit were found similar as sources of potassium for cotton. The need for potassium also varies with local conditions. Manure has given good results, although the supply is quite limited, and the nutrients contained in the manure alone may not be in proportions desirable for cotton on the particular soil. Lime in general has seemed of slight value for cotton. The crop rotation has proved to be an important factor in the economical use of fertilizers for cotton.

211. THE USE OF ALCOHOLIC SALT SOLUTIONS FOR THE DETERMINATION OF REPLACEABLE BASES IN CALCAREOUS SOILS. By O. C. Magistad and P. S. Burgess. (*Tech. Bull. No.* 20, 1928, Agr. Exp. Sta., Univ. of Arizona.)

212. EXPERIMENTAL ERROR. By E. J. Maskell. (Abstr. from *Trop. Agriculture*, v., **12**, 1928, and subsequent numbers.) A survey of recent advances in statistical method.

213. COTTON AND THE GINNING PROCESS. By B. McL. Middleton. (Abstr. from *Indian and Eastern Engineer*, Calcutta, December, 1928.) A brief history of cotton ginning, with descriptions of various types of gins.

214. HANCOCK COTTON PICKER AND THE MURRAY GIN. DESCRIPTION. (*The Hancock Cotton Picker* and *The Effects of Research on Cotton Ginning Machinery*; pamphlets. Murray Co., U.S.A. Abstr. from *Summ. of Curr. Lit.*, viii., **23**, 1928, E. 62.) The Hancock Machine was designed primarily for the purpose of handling "snaps" and "bollies" and preparing all kinds of gathered and trashy cotton for ginning. It has been found also to improve the grade of picked cotton. There are no saws to cut the burrs and hulls. Instead the lint is removed from the hulls by the same kind of flexible card cloth that is used in every cotton mill. Diagrams showing the machine construction are given. The bollies and trash are expelled at one side, free from lint, and the cotton comes out on the other, free from hulls and trash. Photographs of samples are given. Numerous letters from users confirm the claims made for the machine, and indicate that it raises the grade of cotton from one to three grades. A cross-section of the Murray high speed, loose roll, air blast gin is shown. The moting point is far above the nozzle where the lint is blown off the saws, and there is no chance of the motes being blown into the lint. The results of tests on cotton treated by the Murray-Hancock system and by the rigid saw-tooth cleaner systems are compared. The total opening and card waste amounted to 25·8 per cent. in the first case, and 33·4 per cent. in the second. Tests of staple show that the Hancock Picker preserves the long fibre. The yarn finally obtained after the Murray-Hancock system has a breaking strength higher than the standard values.

215. GINNING MACHINE. DESCRIPTION. (E.P. 295152 of November 4, 1927. A. Libert. Forest-Brussels, Belgium. Abstr. from *Summ. of Curr. Lit.*, viii., **22**, 1928, E. 60.) In a cotton gin of the type comprising a gin roller, a doctor knife, and a beater shaft rotating in a grid-like trough, the beater shaft is mounted in vertically adjustable bearings, is polygonal in section, and has reversible blades removably secured to it. The blades may be fitted with brushes, leather or rubber blades, or metallic resilient blades. The cylindrical grid is formed in two parts hinged together and carries a feed hopper. The grid is independently adjustable and is provided with a slot opposite the doctor knife and gin roller. The cotton is removed from the roller by a wooden batten suspended by chains. The cotton is fed into the hopper from a storage hopper by a roller carrying radial pins of different lengths. A sheet metal plate is hinged to the hopper and is slotted at its end to allow passage of the pins on the roller. By altering the inclination of the plate the number of pins operating to feed the cotton from the hopper can be varied and, if desired, the hopper can be completely closed. The grid is maintained in its closed position by springs.

216. CYLINDRICAL BALING PRESS. DESCRIPTION. (*Cotton*, Manchester, **34**, No. 1650, 1928. Abstr. from *Summ. of Curr. Lit.*, viii., **27**, 1929, E. 71.) A small part of the cotton shipped from Guaymas, which is attaining some importance as a cotton port for the production of the Yaqui Valley, Sonora, and Gusave, in the State of Sinaloa, Mexico, is packed in a new type of cylindrical bale weighing approximately 242·5 lbs. Lint is blown from the gins into the top of a condenser which separates the air from the fibre. The two lower drums in the condenser form the lint into a bat 3 ft. wide and about 8 inches thick. The condenser is especially designed to remove small particles of trash and the short fuzzy fibres which would add to the waste at the mill if left in the bale. Directly below the condenser is a small machine for pre-compressing the bat which next passes between two rollers at the top of the press consisting of twelve steel rollers revolving at a common speed. These rollers are so spaced as to leave a cavity 3 ft. long and 22 inches in diameter approximately the size of the bale. The bat is turned round and round upon itself, and the bale becomes heavier but no larger, being confined by the rollers. When an indicator shows that there are about 250 lbs. in the press burlap is fed in and automatically wrapped round the bale. On release, the finished bale rolls on to the floor and the burlap is sewed down the side of the bale and the ends are covered.

217. A SOIL-BORING APPARATUS. By H. Greene. (Reprinted from the *J. of Agr. Sci.*, xviii., Pt. 3, July, 1928.) The following is a description of an apparatus which has been used with success by Dr. Greene in taking samples of the tenacious clay soil at Wad Medani, Sudan: An iron rod of square cross-section is suspended from a tripod by means of two pulleys and a wire cable. Into the lower end of this rod a shell auger is screwed; the upper end carries a ball race and swivel. Slotted weights, which are carried by collars on the iron rod, supply the downward thrust; the turning moment is applied by tillers which are also readily detachable. To secure a vertical bore the iron rod is at first steadied by hand, but as soon as the auger has entered the soil slight tension on the cable suffices for the purpose. When the auger has descended a desired depth the boring assembly is wound up and the sample removed. Two windows in the shell auger facilitate this, but when the soil is sticky the whole auger is detached and another screwed in so as not to delay the boring. The tripod can be folded up and carried by three men, but it is rigid when in use.

Dr. Greene states that with this apparatus it is possible to take a large number of samples from a small area without damaging the crop or disturbing the soil. In speed, accuracy, and working cost the method compares favourably with the use of a hand-borer. Two boring tools of the above type are in use at the Wellcome Tropical Research Laboratories, Wad Medani; they were made by The Millars' Machinery Company, Ltd., of Bishop's Stortford, who have had long experience in the designing of boring machinery.

BREEDING, GENERAL BOTANY, ETC.

218. A PROPOS DE LA SELECTION DU COTONNIER. By E. Miege. (Abstr. from *Coton et Cult. Coton*, iii., 1, 1928, p. 8.) Points out that the yield on the whole increases with the number of loculi in the fruit.

219. A STUDY OF THE LOCULAR COMPOSITION IN CAMBODIA COTTON. By V. R. Ayyar. (*Bull. No.* 178, Agr. Res. Inst., Pusa, 1928.) In this study the following points have been demonstrated:

1. There is seasonal fluctuation in the stigmatic composition of the flowers produced on the same plant; 5-locked bolls are generally produced early in the season.
2. There is a greater percentage of shedding in the case of bolls formed from flowers with 5 stigmatic faces.
3. There is a positive correlation between the number of 5-locked bolls and the remaining number of bolls produced by a plant, and the regression lines are found to be linear.
4. There is a negative correlation between the number of ovules per lock and the locular composition. Yet the total number of ovules in a 5-locked boll is more than in a 4-locked boll.
5. There is greatest variability in the number of ovules in a 5-locked boll and least in a 4-locked boll.
6. When the number of ovules is kept constant, there is no difference in the number of seeds set per lock in all the three types of bolls.
7. There is greater variation in the number of seeds set than in the number of ovules per lock.
8. There is no difference between the maturation periods of 4- and 5-locked bolls obtained from flowers opening on the same day.
9. The kapas weight per seed is least in a 5-locked boll and highest in a 3-locked boll.

220. COMMERCIAL COTTONS: CHARACTERISTICS. By H. Fikentscher. (*Melliand Textilber*, 1927, 8, and 1928, 9. Abstr. from *J. of Text. Inst.*, xix., 12, 1928, A. 410.) Samples of 10 North American, 17 East Indian, 7 Egyptian, 7 South

American, 3 Central American and West Indian, and a Tahiti, a China, a Tientsin, and a Syrian cotton were examined. Brief particulars relating to each of the samples are given. The tests usually employed in the examination of raw cottons are discussed, and particulars are given of the methods used in the present investigation, including an indirect method for estimating mean cross-section. The results of the examination are noted for each of the forty-eight cottons, and in the concluding remarks the author proposes the elaboration of a system of classification in which the individual characteristics, such as colour, impurities, staple length, fineness, breaking length, roughness, and extensibility are separately noted. He suggests that a multi-placed number should be given to a raw cotton, each digit of the number representing a definite degree of any one property, assuming that the full range could be covered by less than ten. Thus, for example, 2,136,548 might represent the characteristics of a cotton taken in the order noted above.

221. THE INFLUENCE OF CHILLING, ABOVE THE FREEZING POINT, ON CERTAIN CROP PLANTS. By J. P. F. Sellschop and S. C. Salmon. (Abstr. from *J. of Agr. Res.*, xxxvii., 6, 1928, pp. 315-338.) In most summer-crop plants constitutional disturbances having a serious influence on them are called into effect when the plants are subjected to chilling, even though the temperature does not go as low as 0° C.

The outstanding result of the investigation was the very evident effects of chilling on certain plants, and the high degree of resistance in others. The duration and the intensity of the cold were important factors in determining the nature of the reactions. An exposure of 24 and 36 hours at 0·5° to 5·0° C. was fatal to rice, velvet beans and cotton. At 5° to 10° C. velvet beans and cotton were injured when exposed for 60 hours.

Marked differences in relative hardiness between varieties of cotton were observed. Trice cotton, which is grown near the northern limit of the Cotton Belt in North Carolina, proved more hardy than Delfos from Mississippi, while Westex, a variety specially bred for Texas conditions, was considerably more tender than either of the foregoing.

A point of considerable interest was the characteristic reactions of different crop plants, not only with respect to differences in degree of injury, but also with respect to the nature of the injury. Cowpeas and rice leaves became chlorotic 24 to 48 hours after chilling, while cotton and soy beans showed brown and white spots respectively, and the grasses in general showed white bands across the leaves similar to those described by Faris in sugar-cane.

In experiments with cowpeas, cotton, and velvet beans, young plants suffered materially more than old plants treated in a similar manner.

Tap-water solutions of various salts were applied to the plants to ascertain whether any salts would act protectively against plant injury by chilling. Equal volumes of tap-water were applied to control plants. Potassium nitrate was found to afford considerable protection, with potassium chloride standing next in order. Then came the control lot, and then, in descending order of effectiveness, the lots to which calcium chloride, calcium nitrate, sodium chloride, and sodium nitrate were applied. Sodium nitrate and sodium chloride were in some cases fatally injurious when chilling was continued for from 36 to 60 hours, the former salt being the more injurious.

222. NITROGEN ORGANIZATION IN PLANTS (trans. title). By V. Bambacioni. (*Ann. Bot.*, Rome, 17, 1926, No. 1. pp. 4 23. Abstr. from *Exp. Sta. Rec.*, 59, 6, 1928, p. 516.) Experimentation, carried on by the author for a long period as to the capability of the aerial parts and of the roots of the plants examined regarding the organization of nitrogen, has not only confirmed the old view that such production goes on in all of the organs traversed by vascular bundles in which carbohydrates come into contact with mineral salts of nitrogen, but has shown also that the roots have in this connection an importance perhaps even greater than have the aerial parts.

223. VARIATION IN SEED FUZZINESS ON INDIVIDUAL PLANTS OF PIMA COTTON. By T. H. Kearney and G. J. Harrison. (Part of Summary from *J. of Agr. Res.*, **37**, No. 8, 1928, p. 465.) Evidence is presented in this paper which shows that in Pima cotton grown in Arizona there is pronounced variation, as between bolls borne in different positions on an individual plant, in the quantity of fuzz or short hairs on the seeds. Rather high and very significant negative correlations between the height of the fruiting branch and the grade of fuzziness of the seeds borne thereon indicate a strong tendency for the bolls on the lower fruiting branches to have fuzzier seeds than the bolls on the higher branches. Lower but still rather significant negative correlations between the number of the nodes on the individual fruiting branch and the fuzziness of the seeds contained in the boll at that node show that seeds produced nearest the base of the branch tend to be fuzzier than those produced farther out on the branch.

These positional relations suggest that better conditions of nutrition may be conducive to greater development of fuzz on the seeds, since it is the bolls borne on the lower part of the plant and near the base of the fruiting branch that usually have the fuzziest seeds. Conversely, the quantity of fuzz tends to be smallest on seeds produced farthest from the roots and from the main stalk of the plant. It is not improbable, however, that changes in temperature or in the length of day as the season advances may be important factors, since the bolls produced near the base of the plant and of the fruiting branch develop while the day and night temperatures are highest and the days are longest; whereas temperatures, particularly night temperatures, are appreciably lower and the days are appreciably shorter during the period of development of the bolls near the top of the plant and farthest out on the fruiting branches.

The magnitude of the variation in seed fuzziness from boll to boll on the same individual is noteworthy. Of the 20 plants examined in this investigation, 13 showed a range of seven grades, and 7 showed a range of six grades, the total variation which has been observed in the Pima variety being represented by nine grades. It is evident that in comparing different strains or varieties of cotton in respect of this character, and in genetic studies, particular care must be used in collecting the seeds. These should be taken either from bolls occupying corresponding positions on the several individuals or from a sufficient number of bolls on all parts of the plant to afford an average sample.

224. COTTON PLANT. SUCTION POWER. By E. Taschdjian. (*Bot. Centr.*, 1928, **154**, from Fortscshr. d. Landwirtsch, 1928, **3**, 159-60. Abstr. from *Summ. of Curr. Lit.*, viii., **27**, 1929, A. 43.) Four Egyptian and twenty-one American varieties were tested by the method used by Eibl, Buchinger, and other investigators. The Egyptian cottons are characterized by high suction powers. The suction force is proportional to the energy of germination of the seeds, the staple length, the crop yields, and the resistance against attack by weevils, and inversely proportional to the life-duration of the variety.

DISEASES, PESTS, AND INJURIES, AND THEIR TREATMENT.

225. THE PROBLEMS OF APPLIED ENTOMOLOGY. By R. A. Wardle. (Pubd. by the Manchester Univ. Press, Oxford Rd., Manchester, 1929. Price 30s.)

226. PARASITE "ZOO." WORK OF THE EMPIRE LABORATORY. (Abstr. from *The Times*, November 29, 1928.) A letter to *The Times* from the Chairman of the Research Grants Committee, Empire Marketing Board, describing the work carried out during the past year at Farnham Royal in the breeding of beneficial

parasites for the destruction of insect pests, and their conveyance to various parts of the Empire. It is stated that the possibilities are being explored of conveying a parasite of the Pink Bollworm from the Sudan to the West Indies, with Farnham Royal as a transmitting centre.

227. SOME PHASES OF THE RELATION OF TEMPERATURE TO THE DEVELOPMENT OF INSECTS. By L. M. Peairs. (*Bull. W. Virg. Exp. Sta., No.* 208, 1927. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., Pt. 12, 1928, p. 642.) A detailed account of experimental work undertaken to investigate many points concerning the effect of temperature on the development of certain insects. The material employed included the larvæ and pupæ of *Heliothis* (*Chloridea*) *obsoleta, F.* (American bollworm). The following is taken from the author's summary.

"The degree of temperature directly affects the rate of development of certain insects, and a straight line curve for the velocity of development expresses this relation best for most of the range of temperature permitting development, a slowing up of acceleration being indicated at the upper end of the curve and the reverse condition at the lower. This latter is probably due to factors other than temperature, the actual effect of which would be to decrease the rate of acceleration. For all points along the straight part of this velocity curve, a given accumulation of temperature, or thermal increment, expressed in day-degrees, will accomplish a constant effect in growth or development. Furthermore, this temperature may be summed up from the zero of the curve, near which point, but somewhat below it, as found by other investigators, development ceases. No definite method of locating this latter threshold of development is suggested. Development is accelerated by variations in the daily temperature. It is evident that the quantity of carbon dioxide produced during a developmental period is near a constant, regardless of temperature, any departure from the constant being probably due to basal metabolism not directly associated with developmental processes. The law of van't Hoff and possibly Arrhenius' formula may be applied to developmental data, but the graphic interpretation provides a more convenient method of analysis.

228. TEMPERATURE DE DESINFECTION DES GRAINES DE COTON. (*Agr. et Élévage au Congo Belge*, juin 1928. Abstr. from *Bull. No.* 84, *Assoc. Cotonn. Col.*, 1928, p. 493.) M. Leplae, Director General of Agriculture at the Ministry of Colonies, Brussels, calls attention to the fact that in disinfection the temperature of the seed must not exceed 70° C. Disinfection in this way not only destroys all larvæ or worms in the seed, but also destroys the spores of the fungus causing cotton anthracnose.

229. STUDIES ON THE RESISTANCE OF CERTAIN INSECTS TO HYDROCYANIC ACID. By A. M. Boyce. (Abstr. from the *J. of Econ. Ent.*, 21, 5, 1928, p. 715.) A progress report. Instances of resistance or increased tolerance of insects to insecticidal treatment are briefly reviewed. A study is being made of the development of resistance to HCN gas of several species of insects. The results of fumigation experiments with *Drosophila melanogaster* Meig. and *Aphis gossypii* Glover are presented.

230. BORDEAUX MIXTURE IN COMBINATION WITH ARSENICAL SPRAYS. (*J. Agr. Sci.*, xviii., pt. iii., 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., pt. xii., 1928, p. 613.) The interaction of Bordeaux mixture with lead arsenate and with calcium arsenate has been studied by an examination of the effects which are produced when hydrated lime is added to the arsenical compounds and when copper sulphate is added to the combinations. The nature of the interaction of calcium hydroxide and diplumbic hydrogen arsenate has been shown to be most complex, and to result in the complete decomposition of part of the lead arsenate and the formation of basic calcium arsenates.

Support is not given to the view that calcium carbonate decomposes diplumbic hydrogen arsenate with the production of soluble arsenic compounds. When lead arsenate, in water, is allowed to interact for long periods with excess of hydrated lime, the amount of basic calcium arsenates formed is such that large quantities of arsenic are brought into solution by the action of carbon dioxide. Under conditions when the calcium hydroxide is rapidly converted to the carbonate, the amount of arsenic rendered soluble is slight.

The conclusion is formed that in actual spraying there is a definite reduction of the risk of arsenical injury when hydrated lime is added to lead arsenate and to calcium arsenate. It is concluded that when the conditions are such that the addition of hydrated lime brings about a reduction of arsenical injury, the use of an "equal-lime" Bordeaux mixture containing an equivalent amount of calcium hydroxide will prove far more effective.

231. We have received from the Agricultural Res. Inst., Pusa, a copy of *List of Publications on Indian Entomology,* 1927. (Obtainable from the Govt. of India Central Pubns. Branch, Imperial Secretariat Bldg., 3 Govt. Place, West, Calcutta. Price As. 6 or 9d.)

232. NIGERIA. A FIRST SURVEY OF INSECT AND FUNGOID INCIDENCE ON IMPROVED ISHAN COTTON. By F. D. Golding. (Abstr. from the *Seventh Ann. Bull. of the Agr. Dept., Nigeria,* p. 17.) A survey has been made of the factors affecting the development of improved Ishan A. and B., and Ilorin—both grown through yams and alone—and of Kabba intercropped with yams. With the exception of Kabba—sown on June 1—all cottons were sown in the first week of July.

The 1927-28 season was peculiar for a remarkably small infestation of cotton stainers; the amount of damage done to the crop by plant bugs—most of which had not been previously recorded as cotton pests in Nigeria; and finally, the prevalence of bollworms, bacterial disease, jassids, and leaf curl.

It was found that the flowering of Ishan A. and B. was about three weeks later than that of Ilorin; also that the flowering of any variety of cotton grown through yams was about three weeks later than that of the same variety grown alone.

Except for the last six weeks of harvesting, the crop from cotton through yams was cleaner than that from cotton grown alone; plant bugs were chiefly responsible for the greater degree of staining on the first-mentioned plots late in the season. These bugs appeared to prefer Ishan A. and B. to Ilorin, and are of considerable importance; it is not yet certain whether their abundance in the present season was abnormal or whether they were attracted by the planting of selected Ishan on a considerable scale for the first time.

The yield of Ilorin exceeded that of the Ishan strains, but the Ishan seed cotton was cleaner, and is of considerably greater value; in addition, there were usually fewer Ishan plants per acre, and a different method of planting—employed for the two species—placed the Ishan at a distinct disadvantage. Boll shedding and mummification were unusually extensive, apparently as a result of the prevalence of major pests; the loss from these causes was from 10 to 17 per cent. greater in the case of the Ishans than in that of Ilorin.

The Ishan strains A. and B. are markedly resistant to leaf curl and jassids, and owing to their later flowering, would be less exposed to damage from stainers than Ilorin. If the plant bug infestation late in the season was abnormal, it seems probable that their yield will more closely approximate that of Ilorin in a normal year.

Ishan A. gave a higher yield than Ishan B., and is more resistant to leaf curl. Ishan E. gave a very poor yield, and is highly susceptible to both leaf curl and jassid attack.

Kabba is susceptible to leaf curl and jassids, and is so late in its flowering that, when grown through yams, the bulk of its crop would not ripen before the end of March. The possibility of the production by seed selection of an earlier flowering strain with some resistance to leaf curl and jassids would seem to merit attention.

233. SOUTH AFRICA. ENTOMOLOGICAL NOTES No. 39. (*Fmg. S. Afr.*, July, 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., pt. xii., 1928, p. 648.) So far natural enemies do not control the cotton bollworms effectively in South Africa. A list is given of the parasites and predators recorded, many of which, however, have not yet been identified; they include the Braconid, *Apanteles diparopsis*, Lyle, and the Pentatomid, *Glypsus conspicuus*, Westw., attacking the larvæ of *Diparopsis castanea*, Hmps.; and the Tachinids, *Linnæmyia longirostris*, Macq., *Paratachina ingens*, B.B. *Phorocera blepharida*, B.B., and *Sturmia laxa*, Curr., attacking the larvæ of *Heliothis* (*Chloridea*) *obsoleta*, F. Parasitism of *D. castanea* hardly ever exceeds 5 to 10 per cent., but that of *H. obsoleta* may reach 50 per cent., especially late in the season.

234. WEST INDIES. COTTON PESTS AND DISEASES IN ST. KITTS-NEVIS. (Abstr. from *Rpt. on the Agr. Dpt. St. Kitts-Nevis*, 1927-28, p. 5.) The Cotton Worm (*Alabama argillacea*) and the Pink Bollworm were the pests chiefly in evidence during the season. On the Government Cotton Farm it was found possible to keep the former under control with calcium arsenate undiluted with lime.

The following diseases were also noted during the season: West Indian leaf mildew and angular leaf-spot disease.

235. AUTHOR AND SUBJECT INDEX TO THE PUBLICATIONS ON PLANT PATHOLOGY ISSUED BY THE STATE AGRICULTURAL STATIONS UP TO DECEMBER 1, 1927. By J. M. Allen. (*U.S. Dpt. of Agr.*, *Libr. Bibliogr.*, *Contr.*, 16, pp. 251, 1928. Abstr. from *Rev. App. Mycol.*, vii., pt. ii., 1928, p. 734.) The "Check List of Publications of the State Agricultural Experiment Stations on the Subject of Plant Pathology, 1876-1920," issued in 1922, being now exhausted, it was decided to publish the present author and subject index covering the publications of the same institutions on phytopathology (exclusive of insect pests) up to December 1, 1927. The subject entries are in a single alphabetical index covering both hosts and parasites, and also including certain general and physiological aspects of the subject. Most of the series of papers begin about 1887, when the Hatch Act grant for State agricultural experiment stations came into force. Since 1914 many technical papers contributed by the stations have been published in the *Journal of Agricultural Research*, and these are included in the index, from which certain anonymous and popular material has been omitted.

236. LEAF-MINING INSECTS. By J. G. Needham, S. W. Frost, and B. H. Tothill. (Williams and Wilkins Coy., Baltimore, Md. 1928. Abstr. from *Ecology*, x., No. 1, 1929, p. 157.) The four orders of leaf-miners—Lepidoptera, Coleoptera, Hymenoptera, and Diptera—are dealt with systematically by families, with numerous illustrations. A detailed index of approximately forty-two pages and a very complete bibliography add to the value of the book.

237. INSECTES NUISIBLES AU COTONNIER A LA GUADELOUPE. By A. Buffon. (*Bull. No.* 84, 1928, Assoc. Cotonn. Col., p. 500.)

238. VERSLAG VAN DEN PHYTOPATHOLOOG. (Report of the Phytopathologist.) (Versl. Dept. Landbouwproefst. Suriname, 1924-27. Paramaribo, 1928. Abstr. from *Rev. App. Ent.*, Ser. A., pt. xii., 1928, p. 603.) Cotton in Dutch Guiana is constantly attacked by leaf-eating caterpillars, especially *Alabama argillacea*, Hb., which can be controlled by spraying with Paris green, and by *Dysdercus* spp., which are more serious, and against which no really effective measure has been found. The numbers of *Aphis gossypii*, Glov., on cotton are kept down by the Coccinellids, *Ceratomegilla* (*Megilla*) *maculata*, DeG., and *Cycloneda sanguinea* L.

239. PEST CONTROL PROBLEMS ON THE WEST COAST OF MEXICO. By A. W. Morrill. (*Sp. Pub., California Dpt. Agr.*, **78**, 1927. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., pt. xi., 1928, p. 561.) In a general investigation of the pest control problems on the West Coast of Mexico, extending over five years, the following pests of cotton were noted: *Alabama argillacea*, Hb., which proved very destructive in 1925, but was controlled by calcium arsenate dust; the Salt Marsh Caterpillar (*Estigmene acraea*, Dru.) which was destructive in the Yaqui Valley in 1925, and proved very difficult to control, since the almost fully grown larvæ were resistant to arsenicals; various species of Cotton Stainers, including *Dysdercus ruficollis*, L., *D. obliquus*, H.-S., *D. concinnus*, Stal, and *D. obscuratus*, Dist., which caused no noticeable damage to cotton.

240. O ALGODÃO EM MOÇAMBIQUE. (COTTON IN MOZAMBIQUE). (Direc. Serv. Agr., Lorenzo Marques, Moçambique, 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., pt. xii., 1928, p. 670.) The principal pests attacking cotton in Mozambique are: *Heliothis* (*Chloridea*) *obsoleta*, F., *Earias*, *Diparopsis castanea*, Hmps., Cotton Stainers (*Dysdercus*), Jassids, and a boring weevil, *Apion* sp. Control measures are discussed.

241. POISONOUS SMOKE FOR WEEVILS. (Abstr. from *Text. Rec*, xlvi., **549**, 1928, p. 79.) To the long list of methods for combating the boll weevil, poisonous smoke has been added. A powder mixture is dropped into the hopper of a smoke spraying machine, from which it is fed into a fire-box, where it ignites and produces a heavy, thick smoke. The smoke is then directed through two pipes projecting down alongside the wheels of the machine, which resembles a large cart, and a blast of air scatters the fumes on the plants. The blowers used are chain driven, and similar to blowers used for drying crops and for ventilation. When in operation, a heavy canvas covering is built around the pipes to keep the fumes from sweeping up and overcoming horse and driver. The canvas also prevents the weevils from flying out of danger. The cost of protecting cotton in this manner is low, as it averages only 20 c. an acre for materials. Some of the large plantation owners expect to adapt the smoke machine to airplane use, so that large areas may be sprayed in a short time.

242. PREDICTING SERIOUS COTTON APHIS INFESTATIONS. By A. L. Hamner. (Abstr. from *J. of Econ. Ent.*, May 21, 1928, p. 736.) One season's results indicate that when a cotton aphis infestation as high as 5 per cent. exists at the time calcium arsenate dusting for the boll weevil is started, a heavy infestation may be expected if as many as four applications are made.

243. PESTS OF COTTON. PT. II. BEETLES, APHIDS, AND FLIES. By Z. S. Rodionov. (In Russian.) (*Def. des Plantes*, iv., **6**, 1927. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., pt. x., 1928, p. 487.) This paper on cotton pests in Transcaucasia is supplementary to one previously noticed (*Cf.* Abstr. 87, vol. v., *E.C.G. Rev.*, p. 75). The insects dealt with are: The Elaterids, *Agriotes meticulosus*, Cand., *Heteroderes bicarinatus*, Reitt., and *Cardiophorus* sp., the Curculionids, *Bothynoderes* (*Stephanophorus*) *strabus*, Gyll., *B. punctiventris*, Germ., *B. nubeculosus*, Gyll., *Tanymecus* (*Megamecus*) *variegatus*, Gebl., var. *robustus* Fahr., *Phacephorus* (?) *umbratus*, Fald., and *Otiorrhynchus fausti*, Stierl., which are most abundant in fields containing weeds; *Epicauta erythrocephala*, Pall., the Tenebrionids, *Tentyria punctipleuris*, Reitt., and *Dasus pusillus*, F., both of which live in the top layer of the soil and may be controlled by poison baits; the Aphids, *Trifidaphis perniciosa*, Nevskii, and *Aphis gossypii*, Glov., *Phorbia* (*Hylemyia*) *cilicrura*, Rond., which caused considerable injury to cotton in 1926, the larvæ feeding on the seed and cotyledons; and *Œcanthus turanicus*, Uv.

A general account is given of the reaction of cotton to the different pests in relation to varying ecological conditions. It is concluded that by a careful study

of their biology and ecology suitable remedial measures might be ascertained and the crop increased by 30 to 40 per cent.

244. STUDIES ON THE AMERICAN BOLLWORM (*Chloridea obsoleta* F.) AND ITS CONTROL IN 1927 IN THE GANDJA REGION (TRANSCAUCASIA). By V. N. Rekatch. (In Russian, with a summary in English.) (Abstr. from *Khlop. Dielo*, No. 7-8, Moscow, 1928, p. 544.) Gives the life history of the pest, and measures for its control by trap crops and by dusting with calcium arsenate and Paris green.

245. LE VER ROSE DU COTON DANS LA RÉGION DU LAC KIVU. By E. Leplae. (*Agr. Élevage Congo belge*, ii., **10**, 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., pt. x., 1928, p. 535.) A short account of the life history, and of cultural and other measures recommended to prevent the spread of Pink Bollworm in the Belgian Congo, where it has recently been discovered. The Government intends to withdraw all sales licences from factories that fail to carry out the disinfection of cotton seed by hot air by means of the officially approved apparatus.

[*Cf.* Abstr. **578**, vol. v., *E.C.G. Rev.*, p. 348.]

246. THE PINK BOLLWORM SITUATION. By C. Lyle. (*Qtrly. Bull. Miss. Pl. Bd.*, viii., No. 1, 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., pt. xii., 1928, p. 645.) A summary is given of the recent developments of the situation with regard to the Pink Bollworm (*Platyedra gossypiella*, Saund.) in the United States. The Mississippi quarantine against seed cotton and cotton seed was repealed on account of a decision of the United States Supreme Court, but a new quarantine has been established owing to the recent discovery of a new infestation, and at present no seed cotton or cotton seed may be shipped from Texas into Mississippi.

247. ON COLLECTING EXPERIMENTS WITH THE PINK BOLLWORM BY THE PURPLE LIGHT TRAP. (In Japanese.) By T. Kanbe. (*Rept. Agr. Exp. Sta., Korea*, iii., No. 4, Suigen, Korea, 1928. Abstr. from *Rev. App. Ent.*, Ser. A., pt. xii., 1928, p. 605.) In an experiment in which different light-traps were used, 70·4 per cent. of the moths of the Pink Bollworm (*Platyedra gossypiella*, Saund.) were collected by a purple light, 17·5 by a white light, 10·3 by a green, and 1·8 by a red light. The moths were mostly caught between 1 and 3 a.m., from July to September, and on an average 46·2 per cent. were females.

248. POISONS FOR CUTWORM BAITS. By C. Lyle. (Abstr. from *J. of Econ. Ent.*, 21, **5**, 1928, p. 748.) A comparison of Paris green with sodium fluosilicate in poison baits against the Greasy Cutworm (*Agrotis ypsilon*) and the Southern Grassworm (*Laphygma frugiperda*). The tests were made in individual salve boxes with about 300 worms, and indicate that Paris green is both more rapid and more toxic.

249. LIGHT TRAPS AS INDICATORS OF CUTWORM MOTH POPULATION. By W. C. Cook. (*Canad. Ent.*, lx., **5**, 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., pt. x., 1928, p. 526.) The author's conclusions are as follows: This study, while admittedly incomplete, demonstrates conclusively that there are limits to the use of light traps as indicators of the cutworm moth population. When a sufficiently large number of catches are averaged, this average will bear a definite relation to the moth population. In this particular instance, about half as many moths are caught in the trap, per hour, as in collecting at flowers nearby. Not all the species present are captured, and probably 10 per cent. of the total would escape a permanent trap. The moths do not come to light in proportion to their abundance as species. There is a definite gradation from strongly phototropic species to those that are negative to light. Further study is needed on this point, as light traps are very widely used as indicators of the relative abundance of species.

These short collections are only fairly reliable for indicating inter-annual variations in population, and a permanent trap may be regarded as much more reliable.

250. CUTWORM INVESTIGATIONS FOLLOWING THE OVERFLOW. By J. M. Langston. (*Qrtrly. Bull. Miss. Pl. Bd.*, viii., No. 1, 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., pt. xii., 1928, p. 645.) Cutworms are usually abundant in Mississippi after the floods, and observations were therefore carried out to obtain information on the effect of the overflow on them and on their natural enemies. The conclusion was arrived at that cutworms cannot survive submergence for more than a week, since the second rise of the river in June and July caused the destruction of heavy infestations, even in one case where the cotton was not killed by the water. The most abundant species of cutworms were *Agrotis ypsilon*, Rott. (greasy cutworm), causing severe damage to cotton, *L frugiperda*, injuring cotton occasionally, and *Prodenia ornithogalli*, Guen. (cotton boll cutworm), causing comparatively little damage. Both Hymenopterous and Tachinid parasites were present, but the rate of parasitism was less than 1½ per cent. as compared with 67·8 per cent. in the unflooded parts of the State.

251. THE INEFFICACY OF A SINGLE APPLICATION OF SOAP AS A CONTROL MEASURE AGAINST *Thrips flavus* SCHR. ON COTTON. By V. V. Yakhontov. (In Russian). (*Khlop. Dielo.*, vii., 5-6. Moscow, 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., pt. xii., 1928, p. 669.) A single application of soap solution (about 1 lb. to 6 gals. water) is sufficient to kill *Thrips flavus* Schr. on cotton, but unless all the surrounding grasses and weeds are included in the application, the cotton will soon become re-infested by larvæ and adults.

252. A MITE OF THE SUBGENUS *Epitetranychus*, Lacher, AS A PEST OF COTTON IN TURKESTAN. By Y. A. Piontkovski. (In Russian). (*Khlopkovoye Dielo*, vii., 5-6, Moscow, 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., pt. xii., 1928, p. 668.) The mite that attacks cotton in Turkestan and has previously been recorded as *Tetranychus telarius*, L., is an undescribed species of the subgenus *Epitetranychus*. Detailed descriptions of the female, the larva, and the egg are given. The duration of attack is from the end of June to the beginning of October. Spraying with a solution of wheat-flour paste or with 1-lb. soap to 9 gals. water, when the cotton plants are in full bloom, has proved the most satisfactory control measure. The mites are attacked by the adults and the larvæ of *Stethorus punctillum*, Ws., and *Scolothrips sexmaculatus*, Perg., and the larvæ of *Feltiella* (*Arthrocnodax*) *tetranychi*, Rübs., *Triphleps nigra*, Wolff, and *Anthocoris cursitans*, Fall.

253. INDIA. COTTON PESTS. (Abstr. from *Sci. Rpts. of the Agr. Res. Inst.*, *Pusa*, 1927-28, p. 72.) From the report of the Imperial Entomologist we learn that cotton shoots were badly affected by *Pseudococcus corymbatus*, Gr., which was parasitized by *Gitonides perspicax*, Dyar. This parasite was bred also from *Monophlebus octocaudata*, Gr.

The study of the habits and life-history of the Braconid (? *Loxocephalus* sp.), which is parasitic on adult weevils of *Myllocerus* 11—*pustulatus* var. *maculosus*, Fst., was continued. Several efforts were made to get the weevils parasitized in captivity, but they all proved fruitless, for the reason that when male adult parasites emerged in the cage, there were no females, and vice versa. At last, in March, 1928, two females and one male emerged within three days' interval of each other, and all these were liberated in a cage which contained weevils that had long been in captivity. For some unaccountable reason the parasites died within two days, but on dissecting the weevils primary larvæ of the parasite were found in two of them. The new facts brought to light during the year under report are:

1. The adult parasites are active at Pusa till early April, and do not disappear after the first week of February, as hitherto believed.
2. In early stages the parasitic larva is very different in appearance to the larvæ of the later stages.

3. A nearly full-grown larva exhibits two pairs of peculiar leg-like protuberances, which are not usually found in other Hymenopterous larvæ.

254. SEXUAL COLOUR VARIATION IN *Heliothis obsoleta*, FAB. By C. E. Smith and N. Allen. (Abstr. from *J. Econ. Ent.*, 21, 4, 1928, p. 633.) It is considered that colour variations of *Heliothis obsoleta* Fab., hitherto treated as varietal characters, are probably specific sexual characters. In numerous dissection records and oviposition observations made at Baton Rouge, Louisiana, in the autumn of 1926 and 1927, it was found that all individuals formerly considered as belonging to the variety *ochracea* Ckill. were females, and those of the variety *umbrosa* Grote were males.

255. ASIATIC LOCUST (*Locusta migratoria*, L.). Various Russian papers dealing with experiments for the control of this pest are abstracted in the *Rev. of Applied Entomology*, xvi., Ser. A., pt. xii., 1928, pp. 659 665.

256. UGANDA. TSETSE-FLY CONTROL. (Abstr. from *Trop. Life*, 282, 1928, p. 23.) To combat tsetse-fly in Uganda, smoke-houses have been erected for the reception of motor traffic passing from fly-belts into fly-free areas. Tsetse has a proclivity for "attacking" motor-cars, clinging to the chassis, and so travelling many miles from infested belts into clean country. Each smoke-house has accommodation for a loaded three-ton lorry, the vehicles being fumigated by smoke generated from damp grass and weeds burned in a portable forge.

257. COTTON DISEASES IN MISSISSIPPI AND THEIR CONTROL. By D. C. Neal. (*Bull. No.* 248, *Miss. Agr. Exp. Sta.*, 1928.) The following is the summary given of the various diseases and the control measures advocated:

Cotton Wilt.—Plant wilt-resistant varieties. Use balanced fertilizers. Maintain adequate organic content in soil.

Rust.—Use potash fertilizers. Add humus to the soil. Drain wet land.

Anthracnose.—Select disease-free seed. Use resistant varieties. Rotate crops.

Bacterial Blight.—Select disease-free seed. Rotate crops.

Sore-shin.—Fertilize plants liberally. Cultivate at frequent intervals.

Minor Boll-Rots.—Rotate crops. Reduce injuries to bolls by such agencies as angular leaf-spot, anthracnose, and insects.

258. ADMINISTRATION REPORT OF THE GOVT. MYCOLOGIST, COIMBATORE, FOR 1926-27. By S. Sundararaman. (*Rpt. Dpt. of Agr., Madras Presidency*, 1926-27. Abstr. from *Rev. App. Mycol.*, viii., pt. i, 1929, p. 17.) A new *Vermicularia* disease of cotton was studied on the Uppam and H.25 varieties—the only ones affected. The fungus first appeared on the seedlings causing spots on the cotyledons and, in some cases, a condition resembling sore-shin of the stems. About 20 per cent. of the seedlings were killed by the disease in one field. A mild attack occurred later on the bolls. Seedlings of the above-mentioned varieties, sown in pots containing soil infected by the *Vermicularia*, contracted the disease and died, while the Karunganni and Cambodia varieties remained healthy under identical conditions.

259. THE INFLUENCE OF MOISTURE AND TEMPERATURE ON COTTON ROOTROT. By J. J. Taubenhaus and B. F. Dana. (Abstr. from *Bull.* 386, Texas Agr. Exp. Sta., 1928.) From the summary we extract the following: "Three climatic factors, rainfall, air humidity, and temperature, have been studied to determine the influence of each on the rootrot disease. Of the three factors, rainfall is outstanding in its importance. Humidity is seen to have no direct influence. Temperature for the crop-producing portion of the season is seen to be favourable to the development of the disease. Toward the end of the growing season, lowered temperatures reduce rootrot severity in spite of favourable moisture.

"A further analysis of the data reveals that an adequate supply of moisture at the early part of the season favours development of the disease regardless of the rainfall additions. In mid-season, however, there usually occurs a drought period which checks rootrot, and in three out of the five years under study, spread of the disease was completely stopped for a considerable period.

"Favourable temperature for rootrot is seen to occur during the crop-producing portion of the season; that is, the temperature is favourable for development of the disease to a high degree of severity. In September and October, however, lowered temperatures become the limiting factor and cause a sharp reduction, but this check in the disease comes so late in the season as to be of little economic importance, since plants dying at this time have already produced a crop which is not greatly injured by such delayed death of the plant."

260. Rootrot in Texas Fields. Decline in Cotton Yield. By J. A. Todd. (Abstr. from *Man. Guard. Coml.*, February 14, 1929.) It is stated that rootrot is becoming a very serious matter in Texas, and the Government have recently begun a thorough scientific survey of the whole position, in the hope of finding out the causes of the damage and what can be done to remedy it.

261. The Action of Sulphur as a Fungicide and as an Insecticide. Pt. I. By W. Goodwin and H. Martin. (*Ann. App. Biol.*, xv., **4**, 1928, p. 623.) It is shown that the volatile agent is sulphur only.

262. The Quantitative Study of Soil Fungi. By W. B. Brierley *et al.* (From the *Proc. and Papers of the First Internat. Cong. of Soil Sci.*, 1927, vol. iii Received from the Dept. of Mycol., Rothamsted Experiment Station.) This summary deals only with the quantitative technique of mass extraction, and the following chief factors are considered seriatim: Sampling, Suspension, Disintegration, Dilution, Plating, Incubation, Enumeration.

263. The Parasitism of *Rhizoctonia Bataticola* (Taub) Butler, and other Fungi. By W. Small. (*Trop. Agriculturist*, lxxi., **4**, 1928, p. 215.)

264. With reference to the much-discussed question as to whether *Rhizoctonia bataticola* is a cause of root disease in plants, several papers by Dr. W. Small and Professor Briton-Jones have appeared in *Trop. Agriculture*, vol. v., Nos. **4**, **5**, **10**, and **12**, 1928.

265. Cotton Leaf-spot Disease. Description. By G. H. Jones. (*Ann. Bot.*, 1928, **42**, 935-47.) The symptoms of an *Alternaria* disease of the cotton plant are described, the entry of the causal fungus into the host is followed, and the inter cellular path of the invading hyphæ traced. The etiology of the shape, position, and time of incidence of the disease lesions is discussed in some detail. The causal fungus, *Alternaria macrospora*, Zimmerm., is described and figured. The varied effects of the causal organism are described and correlated with the physiology of the host. From a short study of the ecology of the disease it is concluded that it is not ordinarily important, though it may possibly prove to be so under very humid conditions.

266. Soil Temperature Studies with Cotton. III. Relation of Soil Temperature and Soil Moisture to the Soreshin Disease of Cotton. By M. N. Walker. (*Bull.* 197, Univ. of Flor. Agr. Exp. Station, Gainsville, Florida, 1928.) During favourable weather the soreshin or Rhizoctonia disease of cotton may necessitate wholesale replanting by reducing germination and by killing young plants. The optimum temperature range for killing lies between 17° C. and 23° C. No minimum temperature for killing was determined, as cotton failed to germinate below 15° C. The maximum temperature at which killing took place was 34° C. There appeared to be a variation in the amount of killing due to variation in the rate of germination of different lots and varieties of cotton seed.

The fungus grew best in culture between 27° C. and 29° C. No growth took place above 38° C., and this appears to be the maximum temperature at which growth can take place. The minimum temperature for growth lies between 7° C. and 11° C.

Practically all soil moistures at which cotton would germinate and grow were sufficient to allow *Rhizoctonia* to attack cotton plants, providing the soil temperatures are favourable to the fungus.

It would appear that there are several strains of *Rhizoctonia solani*, all of which are not capable of attacking cotton with equal severity.

[*Cf.* Abstract **418**, vol. v., p. 270.]

267. CONSEIL INTERNATIONAL SCIENTIFIQUE AGRICOLE. RESOLUTIONS ADOPTÉES A LA PREMIÈRE SESSION, 7 TO 12 NOVEMBRE, 1927. (*Int. Inst. of Agr., Rome,* 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., pt. xii., 1928, p. 650.) The Commission for Plant Pests and Diseases adopted resolutions calling attention to the necessity for the official control on similar lines in all countries of the chemical composition of insecticides, etc., and for tests of their efficiency; for a collection of the literature on the subject of plant protection for international use; for the unification of measures concerning the importation of plants; and for an index of all institutions for the protection of plants, of the work they are doing, and of the scientific personnel attached to them. The resolutions adopted by the sections dealing with cotton pests (*Anthonomus grandis*, Boh., and *Platyedra* [*Pectinophora*] *gossypiella*, Saund.) and locusts are also given.

CHEMISTRY AND PHYSICS IN THEIR APPLICATION TO COTTON PROBLEMS.

268. COTTON. MOISTURE CONTENT DETERMINATION. By J. F. Morrissey. (*Text. World*, 1928, **73.** Abstr. from *J. of Text. Inst.*, xx., **1**, 1929, A. 42.) A simple method is described for rough determination of moisture content. Samples of the cotton are tested by placing in a box with a recording hygrometer. The application of the test at various stages in the process of manufacture is discussed.

269. COTTON. MOISTURE CONTENT DETERMINATION. By W. Watson. (*Text. World*, **73**, 1928. Abstr. from *J. of Text. Inst.*, xx., **1**, 1929, A. 42.) The results of determinations of excess moisture in cotton as received, and its elimination in the opening processes are discussed. The adoption of a moisture regain standard of about 8½ per cent., and a nett weight basis for buying are advocated.

270. RAW COTTON: FINENESS AND TENSILE STRENGTH. By O. Roehrich. (*Rev. Text.*, 1928, **26.** Abstr. from *J. of Text. Inst.*, xix., **10**, 1928, A. 317.) An account is given of the study of the fineness of cotton, and the Calvert-Summers method of measuring the diameter of the hair is described. The significance and calculation of the coefficient of maturation are explained. The method involves determinations of the weight and surface of substance. Various methods for determining tensile strength are reviewed, and a method based on those of O'Neill and Yves Henry is described in detail. One cm. of cotton hair is held between the clips and connected to a float in a vessel containing suitable liquid. The apparatus is fitted in a three-way cock in such a way that level of the liquid may be raised or lowered by adjusting this tap alone. The float is graduated in millimetres so that the height of liquid may be read off at the point of rupture. A formula is given for calculating the resistance to rupture in terms of length, diameter, and coefficient of maturation. The results calculated by means of this formula show good agreement with those obtained by direct measurements. From the tests described it is possible to estimate the technical value of the raw cotton. A few examples are given showing the counts possible.

271. RAW COTTON. STAPLE TESTING. By O. Roehrich. (*Rev. Text.*, 1928, **26.** Abstr. from *J. of Text. Inst.*, xx., **1**, 1929, A. 42.) The use of the Baer apparatus and the construction of diagrams are described. Tables of results obtained for various types of cotton are given. Determinations of the arithmetic mean, commercial length, coefficient of homogeneity, coefficient of "flatness" (*palier*) and the practical mean are explained.

272. THE EFFECT OF HEAT ON COTTON. By A. H. Tiltman and B. D. Porritt (*India-Rubber Jour.*, 76, **7**, p. 9. Abstr. from *Trop. Agriculture*, v., **12**, 1928, p. 328.) Cotton plays an important part in the construction of many rubber goods, and the properties of such articles as pneumatic tyres are largely influenced by the properties of the cotton fibre they contain. Heat is known to affect the properties of cotton fibre. Thus, when heated for twelve hours at 70° C., it loses tensile strength and becomes brittle and less elastic. It will, however, on exposure to moisture and air, regain its normal properties. Heating in the presence of traces of strong acids causes decomposition of the cellulose. The manufacturing process of rubber material containing cotton includes vulcanization, which necessitates strong heating. The addition of sulphur and other chemicals to the rubber may produce traces of strong acids. It will be seen, therefore, that although the initial fabric may be of suitable strength and elasticity, the severe treatment it undergoes may change both its physical and chemical properties. A study of cotton fibre from this point of view showed that heating to above 120° C. caused a permanent loss of strength, and at 240° C. almost total decomposition occurred. The detrimental effect of the heating is due partly to the action of oxygen, and the loss of strength is reduced by the exclusion of air. Application of heat alone appears to affect only the breaking point, and not the elasticity of the fibre.

273. COTTON HAIR. STRENGTH MEASUREMENT. By E. E. Chandler. (*Text. World*, **74**, 1928. Abstr. from *Summ. of Curr. Lit.*, viii., **27**, 1929, L. 65.) A quick method for determining the strength of cotton hairs is described. It consists essentially in preparing a milligram bundle of fibres by combing so that the fibres are parallel and their ends fairly even. The combed bunch is then wrapped with a 20's sewing thread on a machine consisting of an iron stand which supports a wrapping head and scale. Bundles of fibres are tied with the two ends of a thread, and are then wound from both ends until the threads approach within $\frac{3}{16}$ inch of each other. A scale reading is taken, the wrapping is continued for ten turns, and the scale is read again. The difference gives approximately ten times the circumference of the bundle of hairs. The wrapping is continued until the threads are about $\frac{1}{50}$ of an inch apart, when the direction is reversed so that the wrapping moves from the centre to the ends of the bundle. At the point at which the thread moves toward the centre again, the thread is cut close to the bundle and the bundle is placed in the special jaws of an ordinary skein-breaking machine. The machine is operated as for a skein of yarn break; the break should occur with a snap, and after a proper break the ends appear even. Experiments have shown that the method may be satisfactorily used in comparing different cottons.

274. OIL-SPRAYED COTTON. DYEING PROPERTIES. By A. H. Grimshaw. (*Text. World*, 1928, **74**, 1655-6. Abstr. from *Summ. of Curr. Lit.*, viii., **24**, 1928. K. 187.) Dyeing tests on raw cotton sprayed with emulsifiable mineral oil, and on yarns manufactured from oil-sprayed cotton have shown that the direct, vat, and sulphur dyes with which the tests were made penetrated the cotton uniformly and completely.

275. COTTON YARNS. EFFECT OF TWIST. By A. A. Mercier and C. W. Schoffstall. (*Bur. of Standards J. Res.*, 1928, **1**, 733-50. Abstr. from *Summ. of Curr. Lit.*, viii., **25**, 1928, G. 93.) Seven counts of combed yarns from $1\frac{1}{16}$-inch staple middling grade cotton, and five counts of carded yarns from 1-inch staple middling grade cotton were spun, using single and double roving systems, in the Bureau of Standards experimental cotton mill. Different twist factors were used for each yarn. Measurements were made of strength, diameter, angle of twist, and contraction, and the results are correlated graphically with respect to the twist multiplier. A comparison of the curves obtained by plotting the twist multiplier against the skein and single thread-breaking strengths shows that the maximum strength for skein breaks was reached with a twist multiplier of 4·25, whereas for the single thread method the maximum breaking strength was reached with a twist multiplier of about 5·25. This may be partly explained by considering that the single thread result represents an average of a number of tests including high, low, and medium breaks, whereas the skein test is an average of the medium and low breaks. At best, the skein tests grade samples in the same quantitative order as a single thread test. It was observed that yarn of the twist multiplier which would give maximum strength as indicated by the skein method had less tendency to kink. The strength tests by the skein method indicate the benefit obtained by using a double roving instead of a single roving organization. Using low twist multipliers the advantage gained is as high as 15 lbs. in some instances. The single thread tests indicate that little, if any, advantage is gained for high twist yarns. The figures also show that the strength of a yarn increases with twist up to a certain point, then decreases as further twist is added. As twist is added within certain limits, the yarn diameter decreases. When increasing from a twist multiplier of 3 to one of 4·75, using the same roving, the draft had to be increased from 9·25 to 9·75 to correct the contraction in length of the yarn and maintain a constant twist. Two charts, one for determining turns per inch in a yarn, when count of yarn and twist multiplier are known, and the other for determining production in yards per minute or hour when spindle speed and turns per inch are known, are provided, and the use of the data and charts in the mill is discussed.

276. THE DIGESTIBILITY AND FEEDING VALUE OF BULRUSH MILLET (*Pennisetum Typhoideum*). By E. T. Halnan. (From the *J. of Agr. Sci.*, xviii., pt. iv., 1928, p. 639.) A report on an investigation into the value for poultry feeding of bulrush millet grown in Nyasaland, undertaken by the Poultry Nutrition Section of the Animal Nutrition Institute, Cambridge. The author states that the grain was eagerly consumed by both adult and young poultry, and when it was mixed with other grains the birds showed a distinct preference for the millet. In the digestibility trials, the millet formed the sole diet; the ration was eagerly consumed by the birds, which at the end of the trial were in a good thriving condition. Bulrush millet, on a digestibility and composition basis, appears to approximate in feeding value to Little Joss wheat.

(It is hoped that as a result of the publicity given to these trials, a demand for millet for inclusion in poultry food will arise, which may enable this grain to be exported at a profit from the Colonies in Eastern Africa, where it would form a valuable rotation crop in the areas suitable for cotton.—ED.)

277. FATTENING MUTTON SHEEP. RAW COTTON SEED AS A SUSTAINING FEED IN DROUGHT AREAS. By A. P. L. (Abstr. from *Natal Mercury*, November 21, 1928.) Costing about £3 per ton, raw cotton seed has been proved to be both an economical and a wonderful feed for fattening slaughter cattle, and also for sheep. It averages about £2 cheaper than mealies, is not attacked by any devastating insect pests, and is easily stored, necessitating only a covering that is sufficient to keep moisture from it.

278. THE UTILIZATION OF COTTON BURS. (*Jour. of Amer. Soc. Agron*, 20, 1095, 1102. Abstr. from *Trop. Agriculture*, vi., 1, 1929, p. 26.) As the burs contain only 2 per cent. of fat, 7 per cent. of protein, and 45 per cent. of crude fibre, it is somewhat difficult to find a use for them. The cotton-seed hull bran obtained during the manufacture of cotton-seed oil, however, gave more promising results, and it looks as if it might find a commercial outlet as a source of furfural.

MISCELLANEOUS.

279. **WORLD MOTOR TRANSPORT CONGRESS, 1927 (REPORT OF).** This report, a copy of which has recently been received, should be read by all who are interested in the progress of motor transport, which can do so much to open up districts which for financial or other reasons are inaccessible to railways. Among the subjects for discussion at the Congress were the following: "The Development of Motor Vehicles Suitable for Service on Bad Roads and for Cross-Country Use"; "The Necessity for Co-operation between Road and Rail Transport"; "Motor Transport as an Instrument of Development of World Resources."

280. SKINNER'S COTTON TRADE DIRECTORY OF THE WORLD, 1928-29. (London, Manchester, Bradford, New York, Montreal. 30s. net.) This is the sixth issue of this volume, and it is difficult to find fresh words of praise every year for this invaluable work of reference. The thumb-holes, by whose aid easy reference is made to the various sections, are labelled: Contents, Advertisers, Exporters, Merchants and Brokers, Waste Merchants, Spinners and Manufacturers—Great Britain, including a List of Directors, etc., United States, Germany, France, Italy, China, Japan, Other Countries—Yarns, Piece Goods, Fabrics, Artificial Silk, Mill Supplies, Textile Machinery, Electrical, Chemicals.

Since the previous edition was published, very substantial efforts have been made to still further augment the information contained in the volume. The result has been that in the customary revision of all the details a large number of names have been added and valuable additions have also been made to the particulars previously published. This book is absolutely indispensable to all in any way engaged in the cotton trade.

281. THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE. From the Principal's Report for 1927-28 we learn that the Milner Hostel and the College Dining Hall were completed during the year. The Hostel has accommodation for thirty-two students, and the question of the provision of more accommodation by constructing the other wing of the Hostel building will soon have to be considered. The Power Station and the new building for the Low Temperature Research and Cold Storage plant were also completed during the year, and sanction was obtained to proceed with the construction of the new Chemical Block.

The Report records further progress in all departments, and contains a list of the papers published during the year, and the journals in which they have appeared.

282. THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE (TRINIDAD). By C. Y. Shephard. (Abstr. from *Trop. Agriculture*, v., **10**, 1928.) Deals with the history and development of the College.

283. COTTON RESEARCH STATION, TRINIDAD. GENETICS DEPARTMENT. By S. C. Harland. (Abstr. from *Trop. Agriculture*, v., **12**, 1928, p. 303.) An interesting description of the Genetics Department and of the work that is being carried out there.

284. THE LIVERPOOL COTTON ASSOCIATION. CHEAPER THAN NEW YORK. By A. C. Nickson. (*The Commercial Annual Review*, 1928, Manchester, p. 7.)

285. MANCHESTER'S COTTON TRADE. (Abstr. from *The Coml. Ann. Rev.*, 1928, Manchester.) An interesting article on the subject given under the following heads: Keeping down Costs; Waste and no Waste; Spinning and Weaving.

286. THE COTTON TRADE IN 1928. (Abstr. from the *Text. Rec.*, xlvi., **550**, 1929, p. 31.) A review of the Lancashire cotton trade in 1928. Statistics of exports of cotton yarn and cotton cloth are given, and the question of prices and the benefits to be derived from amalgamation of spinning companies are discussed.

287. THE POST-WAR DEPRESSION IN THE COTTON INDUSTRY. By H. Clay. (Abstr. from *J. of Text. Inst.*, xix., **12**, 1928, p. 323.) Deals with restrictive policies and their results; the financial situation, and the problems facing the industry.

288. RESEARCH FOR A COTTON TRADE POLICY. By E. E. Canney. (*Text. Rec.*, xlvi., **548**, 1928, p. 39.)

289. THE EXTENSION OF THE LEEDS UNIVERSITY TEXTILE DEPARTMENT. (Abstr. from *Text. Rec.*, xlvi., **548**, 1928, p. 65.) A description of the new wing which has been added to the Textile Department of the University through the generosity of the Clothworkers Company.

290. THE INCREASING IMPORTANCE OF TECHNICAL EDUCATION TO THE COTTON INDUSTRY. By R. Lees. (*J. of Text. Inst.*, xix., **11**, 1928, p. 253.)

291. TROPICAL HYGIENE. The London School of Hygiene and Tropical Medicine (University of London) have sent us a notice of their lecture courses for non-medical men and women proceeding to the Tropics. One course of nine lectures will be given from April 24 to May 9. Full particulars and a synopsis of the lectures can be obtained from the Secretary, Malet Street, W.C. 1.

292. We regret to learn from the Central Cotton Committee, Moscow, that on January 17 the death occurred at Moscow of Dr. G. S. Zaitzev of the Turkestan Plant Breeding Station.

From 1914 Dr. Zaitzev devoted himself to serious and large scaled genetical, botanical, and breeding work in cotton, occupying the position of Chief of the Division of Plant Breeding of the Golodnostepskay Agricultural Experiment Station till 1919. In that year he was appointed Director of the Turkestan Plant Breeding Station. This position he occupied until his death, which has terminated a life full of scientific achievement in connection with the cotton plant. Dr. Zaitzev also held the appointments of Cotton Specialist in the U.S.S.R. Institute of Applied Botany, Leningrad, and Professor of Cotton Growing at the Agricultural College, Central Asia State University, Tashkent. With his death the Soviet Union and the whole world have lost a distinguished geneticist and plant-breeder of genial character.

ADDENDUM.

PLANT DISEASES. By F. T. Brooks. (Pubd. by the Oxford Univ. Press. London. Humphrey Milford. 1928. Price 21s.) We have recently received a copy of this book, which is a clear and easily understood compendium of the diseases that attack cultivated and other plants, with good references to a great deal of literature. The diseases themselves are dealt with in systematic order, and under each one the generic and specific characters are given, with a short account of the symptoms and of the usual treatment. This method renders the book especially useful to students, while at the same time it calls attention to the yet young and comparatively undeveloped condition of the study of plant pathology, and to the great advances that have yet to be made. The last chapter gives a most useful account of the methods of preparing and using the various fungicides.

CORRECTION.

W. Youngman's article in *E.C.G.R.*, v., p. 35.

In the January number, on p. 43, editorial note, the bracket "Range of Rainfall" should cover the word "total" as well as the months actually covered.

PUBLICATIONS RECEIVED

We have to acknowledge the receipt of the following publications for the Library.

Eden, T., and **Maskell, E. J.**: *The Influence of Soil Heterogeneity on the Growth and Yield of Successive Crops.* (*J. Agr. Sci.*, xviii., pt. ii., April, 1928.)

From the Dept. of Mycology, Rothamsted Experimental Station.

Bristol-Roach, B. M.: *The Present Position of our Knowledge of the Distribution and Functions of Algæ in the Soil.*

Henderson-Smith, J.: *The Transmission of Potato Mosaic to Tomato.*

Stoughton, R. H.: *A Method of Maintaining Constant Humidity in Closed Chambers.*

From the Welsh Plant Breeding Station.

Fagan, T. W. *et al*: *The Effect of Nitrate of Soda on the Yield and Chemical Composition of a Simple Seeds Mixture in the First Harvest Year.*

From the Dept. of Agriculture, Mysore.

Kunhi Kannan, K.: *The Large Citrus Borer of South India.*

From the Dept. of Agriculture, Nyasaland.

Butler, E. J.: *Report on Some Diseases of Tea and Tobacco in Nyasaland.*

Smee, C.: *The Tea Mosquito Bug in Nyasaland.*

From the Dept. of Agriculture, South Africa.

Turpin, H. W.: *Insurance against Drought.*

PERSONAL NOTES

WE much regret to have to announce the death at Stockport in December last of Mr. John C. Atkins. Mr. Atkins represented the Oldham Chamber of Commerce on the Council of the Corporation.

We offer our congratulations to Sir Gerald Hurst on receiving the honour of knighthood for political and public services. Sir Gerald Hurst is Member of Parliament for the Moss Side Division of Manchester, and is also a member of the Council of the Corporation.

We also offer our congratulations to Sir William Thompson on receiving the honour of knighthood. Sir William Thompson, as President of the Manchester Chamber of Commerce during 1928, represented that body on the Council of the Corporation.

We are delighted to record that a baronetcy has been conferred on Mr. Eckstein, Chairman of the Sudan Plantations Syndicate from its inception up to last year. Mr. Eckstein has laboured without stint on behalf of this great undertaking, and the benefits he has conferred on the people of the Sudan are of the most far-reaching nature.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the colonies.

At the date of writing, the following officers are on leave in England from cotton-growing countries:

Gold Coast	Mr. R. H. Bunting.
„ „	Mr. J. C. Muir.
„ „	Mr. A. W. Paterson.
Kenya Colony	Mr. C. G. Bishop.
„ „	Mr. W. G. Lockie.
„ „	Mr. W. L. Watt.
Nigeria	Mr. A. de K. Frampton.
„	Mr. K. T. Hartley.
„	Mr. J. P. Walters.
„	Mr. E. M. L. Watson.
Tanganyika	Mr. L. C. Edwards.
Uganda	Mr. R. T. Wickham.

The following officers of the Corporation's staff abroad are on leave, or will shortly be arriving in this country:

Nigeria	Mr. G. Browne.
Nyasaland	Mr. J. V. Lochrie.
„	Mr. C. B. R. King.
South Africa	Mr. F. S. Parsons.

Printed in Great Britain by Billing and Sons Ltd., Guildford and Esher

THE EMPIRE COTTON GROWING REVIEW

VOL. VI. JULY, 1929. No. 3

THE EIGHTH ANNUAL REPORT OF THE CORPORATION

In presenting the Report to the Administrative Council at the Eighth Annual Meeting held on June 3, the Chairman of the Council, Mr. R. H. Jackson, gave a brief summary of the principal matters dealt with, as follows:

" Prior to the submission of the Report to the General Meeting, I should like to run through the principal matters with which it deals before formally moving its adoption.

" Turning first of all to the table of crops presented at the end of the Report, it will be seen that the total output unfortunately shows practically no increase on that of 1926-27. This fact, however, should not, I venture to think, be regarded with too much misgiving. The general decline in crops experienced in 1926-27 was probably due more than anything else to the marked drop in prices that year, which caused considerably smaller areas to be planted. This effect naturally continues to be felt, though to a decreased extent, in certain of the more important cotton-growing parts of the Empire. In addition, the season 1927-28 was, unfortunately, by no means too favourable from the climatic standpoint. If, however, we look ahead to the season 1928-29, there is good ground for satisfaction. We all know that estimates of crops are by no means always fulfilled; but if the final figures confirm those estimates which have already been received, a gratifying increase will be observed next year. For example, the Sudan is estimated to produce roughly 163,000 bales against 126,000 bales last year, and Uganda 190,000 bales against 138,000 last year, while in Nigeria the output will also probably show an increase of perhaps 30 per cent.

" Turning now to the chief countries dealt with in the Report: as regards India, the item which will probably be of greatest interest to Lancashire is the steady increase in the output of cotton of ⅞ inch staple and over. Experimental work carried out and assisted by the Indian Central Cotton Committee is thus having its effect on improving the quality and staple of a considerable proportion of Indian cotton.

"In South Africa and in Southern Rhodesia we are continuing our experimental work with a view to producing a type of cotton which shall be suitable to the local climatic conditions and resistant to the prevailing pests. So far as the Low Veldt is concerned, I do not think it is too much to say that this work of breeding a new type of cotton which should be specially resistant to the jassid pest has materially changed the attitude of the local farmers towards cotton growing. Two years ago they were on the point of giving it up altogether; this year it has been found impossible to supply them with all the seed they want. In this connection it is gratifying to be able to tell you that at our Executive Committee this morning a resolution was reported from one of the English cotton-growing companies with properties in Swaziland expressing the thanks of their directors to the Corporation and to their South African staff for the work they were doing and the benefits which the company had derived from it in the supply of jassid-resistant seed.

"In Rhodesia also, when our staff began work at the plant-breeding station at Gatooma, they practically set to work to restart the cotton-growing industry altogether, beginning, as in South Africa, with an attempt to produce a type of seed suited to the existing conditions. These types have been raised and are being multiplied with success. They are not yet available in commercial quantities, but the multiplication plots are reported to have done remarkably well in a none too favourable season, and the ultimate development of a prosperous cotton-growing industry within the next two years is expected with confidence, not only by the Corporation's staff, but by all the farmers who have had experience of the new varieties.

"In the Sudan the output of Sakel cotton from the Gezira has shown a marked recovery from the figure of 1926-27, and though the larger output is derived from an increased area under irrigation, there is also a slightly higher yield per acre. The Government continue to do their utmost in the development of rain-grown cotton in the Southern Sudan, and after carrying out experimental work in many parts, they have decided to concentrate on the Nuba Mountains, Mongalla, Bahr el Ghazal, and the Upper Nile, which apparently hold out the best promise. In the season 1927-28 the results in the Nuba Mountains and the Upper Nile were the most promising. It will, of course, be realized that transport is none too easy from these somewhat remote districts, but the problem is receiving the full attention of the Government, who are using whichever form of transport seems best suited to local conditions—river steamer, motor lorry, or camels.

"The extension of the Kassala railway from Gedaref to Sennar, where it joins the main line, is expected to open up an area which enjoys a better rainfall than the district to the north of it, and should be able to produce good crops, but provision will have to be made for water storage for the inhabitants, and this may be a limiting factor as regards the number of possible new settlers in the district.

"In Uganda the Agricultural Department are turning their special attention to improving the quality of the cotton. The output is considerable, and, as I have said, should not fall far short of 200,000 bales this season.

"The Department realize, however, that the improvement of the yield per acre and of the quality necessitates a strict control of the seed supply. Steps have already been taken in this direction, and since our Report was written we have received details of the proposals for dealing with the position in the Eastern Province, where arrangements have been made for cotton to be grown under supervision in a segregated area separated by a wide belt—on which no cotton will be allowed to be grown—from the nearest cotton on either side of it. In this area the transport of seed cotton, both into it and out of it, will be prohibited. The cotton to be grown in the area will be all of one strain, and will be supplied by the Cotton Botanist from the Government experiment station. By this means it is hoped that the seed will be kept pure, and an organization is being perfected whereby this selected seed will be further multiplied and put into general distribution throughout the Province, while it will also be possible, it is hoped, to issue an entirely fresh seed supply for the whole Province once in seven years.

"Tanganyika and Nyasaland are the only two places to show a substantial increase in output as compared with the previous year. The figure of nearly 33,000 bales for Tanganyika Territory easily constitutes a record for that Territory, and is rather higher than the Director of Agriculture was able to predict when our Report was written.

"In Nyasaland the outstanding feature is the steadily increasing proportion of cotton grown by natives. In the hope of extending this still further, the Corporation, with the ready co-operation of the Nyasaland Government, are establishing a new experiment station near the west shore of Lake Nyasa, where there is quite a large population, many of whom, it is believed, will be ready to grow cotton when they can be shown the material advantages to be derived from it. It is first of all necessary, however, to carry out experimental work in order to determine such essential points as the best time for planting, and so on.

"In Nigeria, as you will see from the Report, we have decided to extend our seed farm with the intention of having ultimately about 1,000 acres under cotton. Progress has been rapid in this direction, and in the season 1929-30 there will already be nearly 400 acres under cotton. In the season just concluded the climatic conditions were not too good in any part of the Northern Territory, and our yield per acre on the seed farm was not so high as in the previous year. This is partly to be accounted for by a rather severe attack of bollworm. Since the Report was written the Director of Agriculture has sent us his report for the six months ending March 31, 1929, and he there states that in the Northern Province the crop per acre was probably about 25 per cent. below the average. Considerable extension of cotton-growing is taking place now in the Sokoto Province; the British Cotton Growing Association erected a ginnery at Gusau in 1923-24: since that time the purchases of cotton in the Sokoto Province have increased from 2,500 to 7,300 bales. One result of this is that the new railway which was opened in January is likely to pay its way from the very start. In this connection it may be of interest to repeat what the Director of Agriculture writes as regards possible competition between cotton and ground-nuts. His view, based on the experience of the Department, both in the districts and on their own farms, is that these two crops are only competitive to a very limited extent, ground-nuts being the crop for sandy soils and cotton for heavier ones. In the Director's opinion, only very extreme market changes would lead to any considerable replacement of one crop by the other on its own soil.

"There is very little to be added to what is written in the Report regarding the Gold Coast, West Indies, Ceylon, and Fiji.

"On his return from his visit to Trinidad, Sir James Currie expressed confidence that the Corporation's fundamental Research Station was doing valuable work, and paid a tribute to the high ability of the staff. Mr. Engledow, of the School of Agriculture, Cambridge, has recently been visiting the Imperial College in Trinidad on behalf of the Empire Marketing Board, and the Corporation took the opportunity of asking him to visit at the same time their Cotton Research Station. Sir James and Mr. Engledow hope to issue a joint report shortly, and in these circumstances I do not think it advisable to add anything further to what has already been recorded in our Annual Report.

"I can add little to the section which deals with Studentships, as the last day for the receipt of applications for Studentships for next year is only due next week. I am informed, however, that on paper the qualifications of the candidates appear to be above the average of recent years, and that in view of the reduction of the number of Studentships to be offered, to which reference is made in the Report, the Selection Committee will probably not have too easy a task. The Executive have fixed the number of Studentships to be awarded this year at ten, and four of these will probably be filled by men who held Junior Studentships last year.

"It is unnecessary for me to expand what has been written in the Report as regards mechanical transport. The supreme importance of improved transport facilities has frequently been emphasized. The preliminary experimental work undertaken by the Corporation has had its results, and I think we may look with confidence to the developments which should follow the formation of the Committee set up by the Government to consider this important problem in all its aspects, and to conduct experiments with a view to its solution.

"In considering which are today the most important factors affecting the further increase in the crops of Empire-grown cotton, I am convinced that what is needed at the present time is rather to increase the yield per acre than to extend the acreage. The first essential towards the attainment of this object is scientific plant breeding, which aims at producing the type of seed best suited to the local conditions. This the Corporation's staff are doing to the best of their ability in the various countries in which they are operating. The next stage must be a rigid control of the seed supply by the Government, to ensure that it is kept pure during the stages of multiplication until sufficient is available for general issue. The effective control of seed to prevent admixture is possibly one of the most difficult problems in connection with cotton-growing which confront the several Departments of Agriculture; but at the same time it is probably also the most important single agricultural factor likely to bring about an increase in the crops for export.

"Another object which must be attained if the output by native cultivators is to increase is that they must be satisfied with the sum they receive for their produce. Here the problem is partly agricultural and partly economic, as the return to the grower depends both on the yield he can obtain per acre and the price per pound he can secure for his cotton. The yield per acre can almost certainly be considerably improved through improved cultivation and by seed control; the question of price is not within the control of the local Governments, but in this direction also they can help by organizing and supervising the markets in such a way as to secure that the grower receives for his crop the best price compatible with the world price for cotton at that time. This price again varies from place to place, owing to the variations in the cost of getting the produce from the producer to the consumer. By wisely spending money on carefully thought out schemes of transport development, the local Governments will consequently be able to help considerably in enabling higher prices to be paid in the local markets, and thus conducing to the prosperity of the native populations."

THE INDIAN CENTRAL COTTON COMMITTEE TECHNOLOGICAL LABORATORY

BY

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History.—The Indian Cotton Committee, in its Report to the Government of India, recommended that the Central Cotton Committee should include on its staff a Cotton Technologist to carry out laboratory tests on Indian cottons for Agricultural Departments, secure authoritative valuations, arrange for and interpret spinning trials, and also carry out general scientific work on Indian cotton fibres. The Central Cotton Committee itself was strongly in favour of such a laboratory, and immediately funds became available by the Cotton Cess Act of 1923 it authorized the building of a spinning laboratory in Bombay: this was begun in September, 1923, and in August, 1924, the laboratory began to make spinning tests. The Director of the laboratory had meanwhile been appointed, and took up his duties in Bombay in January, 1924. Plans were shortly afterwards prepared for a research laboratory for the fibre investigation, and on December 3, 1924, His Excellency the Viceroy, the Earl of Reading, signalized the importance of the new laboratory by himself formally opening the spinning laboratory and laying the foundation-stone of the research laboratory. The latter building was completed and occupied in September, 1925. These laboratories were erected and equipped at a cost of about 5 lakhs of rupees, or nearly £40,000.

Work.—The work of the Technological Laboratory falls into two main divisions: firstly, the undertaking of spinning tests; and secondly, the measurement of the fibre properties of the cottons which are subjected to the spinning tests, with the object of ascertaining, if possible, the connection between such fibre properties and the spinning value of the cotton. The following brief account explains this two-fold activity of the Technological Laboratory.

The ultimate reasons which led to the establishment of the Technological Laboratory were the difficulties which cotton breeders in India experienced in getting definite valuations of their new types.

As cotton is grown to meet the demands of the spinners, it follows that the final judgment on a cotton must be based on the quality of yarn that can be spun from it. But while in all cases the spinning test must remain the ultimate court of appeal, long experience enables cotton graders to estimate a cotton's quality with considerable accuracy merely by a hand-and-eye examination; but when a cotton has to be examined which, by virtue of its newness, is outside their experience, their judgment of spinning value is liable to err. And yet the cotton breeder needs a judgment as to the quality of his new types at the earliest possible stage in their life-history. The Technological Laboratory meets this need by carrying out spinning tests on comparatively small samples of cotton. The spinning laboratory of the Technological Laboratory has been fully equipped to carry out this primary function. It possesses two ring frames (48 spindles each), and a mule (194 spindles), together with all the preparation machinery needed for these spinning machines. In addition it is equipped with a Nasmith combing set of the most recent pattern for special work. A feature of the laboratory is the very complete range of testing instruments for examining the characters of the raw cotton used and the yarn produced.

While the spinning test is at present essential and must always remain the ultimate test of the quality of a new cotton, it is open to certain objections. It is somewhat expensive and relatively slow; it requires a fair amount of cotton; and the cotton breeder cannot make the test himself. Obviously, the spinning value of a cotton must depend upon the physical and chemical characteristics of the fibre; the problem is to find which are the characteristics that matter, and to what extent. If this problem could be solved it would be a tremendous help to the cotton breeder. By making a few measurements he would be able to obtain a good idea of the spinning value of his cottons. It is these considerations which underlie the second branch of the activities of the Technological Laboratory. All cottons subjected to spinning tests are also subjected to numerous fibre measurements, so that information is being collected which will, it is hoped, eventually make it possible to solve the fundamental problem of the laboratory and correlate the properties of the cottons with the results of the spinning tests.

Some indication of the work which has been done by the Technological Laboratory is afforded by the following figures. The numbers of samples tested in successive seasons, beginning with 1924-25, are: 54, 111, 128, 130. Each sample of cotton submitted for test is normally divided into two lots, each of which is then spun separately into three different types of yarns; the numbers of separate lots tested in the successive seasons are: 120, 292, 300, 310; and the numbers of yarns spun in the successive seasons are: 354, 846, 857, 843. It will be seen that there has been little change in the figures during the last three seasons, the reason being that during all this time the spinning plant has been working continuously at its full capacity.

Much work has devolved upon the yarn-testing section in the testing of all these yarns; in 1924-25 about 170,000 individual yarn tests were made, and in each of the three following seasons the number of individual yarn tests was about half a million.

Samples of cotton have been tested for most of the cotton-growing areas, the numbers for different provinces for the years 1924-28 being as follows: Bombay, 88; Punjab, 15; United Provinces, 24; Madras, 94; Central Provinces, 7; miscellaneous, 20.

The results of these tests have been embodied in a number of spinning-test reports which are not made public, but are submitted only to the Agricultural Officers and Departments from which the samples come. Up to the end of the season 1927-28 no less than sixty-seven spinning-test reports and eight special fibre-test reports had been issued. It is gratifying to note that the spinning test reports have been much appreciated, and that already they have proved of considerable value to the Agricultural Departments in deciding their policy concerning the types of cotton to select for multiplication and general distribution.

The Standard Indian Cottons.

In addition to all this unpublished work for the Agricultural Departments, the Technological Laboratory has been making headway in the solution of its own special problems. When the laboratory started work the question immediately arose: What are to be our standards? Fortunately, during the previous twenty years much progress had been made by the Departments of Agriculture, leading to the introduction of a number of improved strains of cotton. These strains were therefore selected as standards in preference to the more widely known but more variable commercial types of Indian cottons. There are now eighteen of these cottons, a classified list of which is given below (p. 220).

Nearly all the research work at the Technological Laboratory has been made to centre round these standard cottons. It is evident that the highly intensive study of a series of cottons, known to be of stable type and in most cases botanically pure, affords the greatest hope for the successful solution of the problem before the laboratory, especially if this investigation is repeated season by season as the cottons of the new crops become available. It is probable that already the standard Indian cottons are the most-tested set of cottons that the world has seen. The work was begun on the standard cottons of the 1923-24 season, and has been continued and extended ever since. At first, the only tests made on these cottons besides the spinning tests were the measurements of their average fibre-length, fibre-length distribution, fibre-width, and the number of convolutions. An investigation was made as soon as possible of other fibre properties—viz., the fibre-strength, the fibre-weight per inch, and the fibre-rigidity. These additional tests have been made not only on the cottons of later seasons, but also, as opportunity offered, on the cottons of the earlier seasons. Gradually a great mass of information about these cottons has been accumulated, which is now being subjected to statistical analysis. The results of these annual tests on the standard Indian cottons have been reported year by year in the following publications:

Bulletin No. 4, Technological Series, No. 1, " Explanatory Note on the Conduct of Spinning Tests in the Technological Laboratory, and Standard Cotton Test Reports," April, 1925.

Bulletin No. 6, Technological Series, No. 2, " Results of Spinning Tests on Standard Indian Cottons," May, 1926.

Bulletin No. 7, Technological Series, No. 3, " Technological Reports on Standard Indian Cottons, 1923-26," May, 1927.

Bulletin No. 11, Technological Series, No. 6, " Technological Reports on Standard Indian Cottons, 1927," November, 1927.

Bulletin No. 16, Technological Series, No. 11, " Technological Reports on Standard Indian Cottons, 1928," June, 1928.

The most recent information about the standard Indian cottons is contained in " Technological Reports on Standard Indian Cottons, 1928." This consists of reports of a uniform nature on each of the eighteen standard Indian cottons and on three American cottons introduced into the series for comparative purposes. Each report is divided into the following five sections: (i.) Agricultural Details; (ii.) Grader's Report; (iii.) Fibre Particulars; (iv.) Spinning Tests; (v.) Remarks. The agricultural details provide some idea of the relation of the standard cotton to the commercial crop of the district, the history of its introduction, its growing period, the soil and climatic conditions in which it is grown, and the magnitude of the crop of the new cotton. The grader's report shows his estimate of various characters of commercial importance. The fibre particulars include the fibre-length, the fibre-length distribution (also shown graphically), the fibre-weight, the fibre-strength, the fibre-strength per unit fibre-weight, the fibre-rigidity, the fibre-width, and the number of natural twists in the fibre. The " spinning tests " section comprises a description of the treatment given in the spinning machinery, the spinning master's report on the cotton, a yarn examination report for evenness and neppiness, together with a table of spinning test results, including the waste percentages, the ring-frame particulars, the results of lea and single thread tests, and figures showing the physical conditions of temperature and humidity prevailing during the spinning and testing respectively. The " remarks " section briefly summarizes the main conclusions which may be drawn from the results of the fibre-tests, the amount of waste made, the number of yarn-breakages in the ring frame, and the results of the various tests and examinations to which the yarns are subjected —particularly with reference to the question of seasonal variation.

The reports are prefaced by a note which describes the objects of the tests as being, generally, to accumulate data for the investigation of the methods of determining the quality or intrinsic value of a cotton, and specifically: (i.) to prepare a series of standards by which to judge other cottons, particularly new cottons produced by cotton breeders; (ii.) to determine the extent to which these standard cottons are affected by seasonal variation; and (iii.) to assist in the marketing of these cottons by providing the cotton trade with detailed information concerning them.

It is pointed out that for spinning purposes the intrinsic value of a cotton comprises three factors—the quality of yarn which can be made from the cotton, the behaviour of the cotton during spinning, and the amount of waste to which the cotton gives rise.

The remainder of the prefatory note is chiefly devoted to a fairly detailed discussion of the following:

1. The reasons why it is important to know what is the minimum weight of cotton necessary for a spinning test.

2. The validity of adopting a special routine for spinning tests on small samples.

3. The special routine adopted at the Technological Laboratory for spinning tests on small samples.

4. The various examinations and tests to which the raw cottons and the spun yarns are subjected.

The note concludes with a discussion of four main points arising from the various general results obtained in the course of the tests:

(i.) THE CHARACTERISTICS OF THE VARIOUS STANDARD INDIAN COTTONS.—The cottons are divided into four classes:

Class I., Suitable for 30's and over.

Bombay.—Dharwar 1 (Kumpta), Gadag 1 (Dharwar-American), Surat 1027 A.L.F.

Punjab.—Punjab-Americans, 285F and 289F.

United Provinces.—Cawnpore-American C.A. 9.

Madras.—Coimbatore Co. 1 (Cambodia 295), Nandyal 14 (Northerns).

Class II., Suitable for Counts between 20's and 30's.

Punjab.—Punjab-American 4F.

Madras.—Hagari 25 (Westerns), Karunganni C7.

Hyderabad.—Umri Bani.

Class III., Suitable for Counts between 10's and 20's.

Bombay.—Wagad 4, Wagad 8 (Dholleras).

United Provinces.—Cawnpore K.22, Bundelkhand J.N.1.

Class IV., Suitable only for Counts below 10's.

Punjab.—Mollisoni (*desi*).

United Provinces.—Aligarh A.19 (Bengals).

(ii.) SEASONAL VARIATION OF THE STANDARD INDIAN COTTONS.—Another direction in which these tests on the standard Indian cottons are expected to prove of value is the light which the repeated annual testing will throw on the question of seasonal variation and possible deterioration. Few facts are more indisputable than that deterioration of well-known commercial varieties of cotton has often set in after a number of years. But while the fact is indisputable, the explanation of it has been a matter of some controversy. There are those who think that deterioration of any and every variety is bound to occur at some time or other, and that there exists a definite term for any variety beyond which its quality is certain to fall off. On the other hand, the modern scientific view is that the so-called deterioration that has occurred in the past has really been due to contamination of the variety by natural crossing in the field with other and inferior varieties. But quite apart from any long-period deterioration of this kind that may be due to the factors of inheritance, there is the deterioration of quality that may be caused in any one season by an unfavourable environment. This is a matter of great economic importance, because different varieties of cotton do not react in the same way to adverse conditions, and, other things being equal, it is evident that that variety is to be preferred which suffers least under such adverse conditions as may be experienced in a locality generally suitable for it.

From the results at present available—for at least four seasons in most cases—it is deduced that there is no evidence to show that any of the standard cottons have undergone deterioration of type within the period concerned. If the deterioration had been one of type, a more or less progressive falling off in the highest suitable counts might have been expected to occur, but no such falling off can be discerned. It may be, of course, that it would take more than four or five seasons to detect any deterioration of this kind owing to the predominating effect of seasonal variation due to other causes; conclusions on this point can in the nature of the case only be arrived at after the expiry of a number of further seasons. It may be mentioned that the variation which has occurred is ascribed to climatic and other differences; this is strikingly borne out by the fact that the seasonal variation is widely distributed, occurring in cottons grown in a number of the different provinces. There is no doubt that as the years pass, and these and other tests are repeated, the information obtained will become more and more valuable.

(iii.) THE RELATION BETWEEN FIBRE PROPERTIES AND SPINNING VALUE.—It has already been explained that the fundamental problem confronting the laboratory is that of explaining the spinning performances of a cotton in terms of its fibre-properties. It is hoped that the extended examination of the fibre-characters of the standard Indian cottons will provide the basis of a really scientific attempt to evaluate just those properties which matter.

Comparisons have been made between the several fibre-properties and the highest warp counts for which each cotton is suitable. It is found that when the different cottons are arranged in order of increasing coarseness of highest suitable counts, there is a general trend in the values of any given fibre-property similar to that of the counts, but in all cases there are outstanding exceptions. The parallelism is most marked in the cases of fibre-length and ribbon-width, and less so in fibre-strength, fibre-weight, number of convolutions, and fibre-rigidity. However, there are so many individual exceptions to each general trend that it is concluded that no single fibre-property can serve as a universal criterion to indicate the highest suitable counts into which a cotton can be spun. It is evident that a number of properties must be taken into consideration, and that the culmination of this work, leading to the assigning of a definite numerical fraction to the part taken by each fibre character, will be a matter of some years' further investigation.

(iv.) THE RESULTS FOR THE 1927-28 COTTONS.—Taken as a whole, the standard cottons of the 1927-28 season give the same spinning-test results as in previous seasons. Some differences have been observed, however, in the fibre-properties of the cottons; the most outstanding of these differences are the much increased fibre-weights of all the Punjab cottons and the much reduced fibre-weights of both the Wagad cottons in 1927-28 as compared with 1926-27. These changes are accompanied by similar changes of greater or less degree in the fibre-strengths and fibre-rigidities. It is believed that all these changes are associated with a shortage of water in the Punjab in 1926-27, and the occurrence of floods in the Dholleras tract in 1927-28. It is remarkable that such great changes have been almost without effect on the spinning capacities of the various cottons.

THE SPINNING TEST.

The Technological Laboratory is in rather a peculiar position. It has to spin nearly 1,000 different types of yarn per annum. In the ordinary way, general mill practice would demand for each particular yarn many changes in the settings and the speeds of the various machines through which the cotton passes when being converted into yarn. But this involves great loss of time, with a corresponding reduction in the number of samples tested. For this reason a number of experiments have been carried out at the Technological Laboratory to determine how far these changes are necessary, and what differences are caused in the results of the spinning tests by reducing the number of changes to the minimum possible. These investigations comprise, therefore, a subsidiary study of the spinning test itself. They are of considerable interest to the cotton spinner because they indicate how far certain traditional beliefs associated with cotton spinning are correct, as in some cases it is the first time that they have been subjected to systematic scientific investigation. Publications have already been issued dealing with some of these matters. These publications are the following:

1. "Spinning Tests on Small Samples," included in "Reports on Standard Indian Cottons," Technological Series, Nos. 2, 3, and 6 (pp. 4, 3, and 6 respectively).
2. "The Effect of Temperature and Humidity on Cotton Spinning, with Particular Reference to Conditions in Bombay," Technological Series, No. 4, August, 1927.

3. "The Effect of Subjecting Cotton to Repeated Blow-Room Treatment," Technological Series, No. 5, September, 1927.

4. "The Effect of Different Spindle Speeds on the Results of Spinning Tests," Technological Series, No. 9, May, 1928.

5. "The Effect of Using Unbalanced Drafts instead of Balanced Drafts in the Spinning Preparation for Spinning Tests," Technological Series, No. 10, June, 1928.

THE SCOPE OF TEXTILE INVESTIGATIONS.—One great difficulty in all textile investigations of the kind undertaken at the Technological Laboratory is that the results are subject to sampling errors, no matter what precautions may be taken to avoid them. At the end of any investigation, therefore, the question arises: May the results obtained be merely the consequence of sampling errors? There is no doubt that in the past too little attention has been paid to this possibility, and misleading conclusions have been reached in an all-too-facile manner on comparatively scanty evidence. At the Technological Laboratory an attempt is made to overcome this objection; this attempt necessarily involves a great multiplication of the work, but this is unavoidable if the results are to be such as can be relied upon.

As an example of the method adopted at the Technological Laboratory, reference may be made to an investigation of the effect of differences in the physical conditions of spinning on the results of the spinning tests. Experiments were made under three different sets of conditions. Not one cotton variety was tested, but seven. For each set of conditions, a sample of each cotton was divided into two lots and each lot spun into three sets of yarns; each yarn was subjected to an examination for evenness and neppiness, and no less than 50 lea tests, 100 single-thread tests, and 100 twist tests were made upon it, so that this investigation included 6,300 lea tests, 12,600 single-thread tests, and 12,600 twist tests. Observations were also made as to the behaviour of the cotton during the spinning processes through which it passed; all the results for the three types of yarns of each of the two lots were taken into consideration in arriving at a decision as to the performance of the cotton under the given set of conditions. Finally, the results for each cotton under each set of conditions were examined, and the evidence carefully weighed as to whether any difference in the reaction of different cottons to the different conditions might be due to real characteristics of the cottons or be merely a consequence of sampling errors. If sampling errors are suspected, the cotton behaving in an apparently anomalous fashion is retested under the same conditions as previously—when, if the performance is really characteristic of the cotton and not a sampling error, the cotton should of course repeat its previous performance.

SPINNING TESTS ON SMALL SAMPLES.—At the outset, one of the most important questions that had to be faced at the laboratory was: What is the minimum weight of cotton necessary for a trustworthy spinning test ? The average spinning master would probably reply, " At least 100 lbs." And where large supplies of the cotton are available, and it is desired to test the cotton under ordinary mill conditions and without special facilities, the practical man would doubtless be correct in his answer. But where special conditions and facilities do exist—as at the Technological Laboratory—it does not by any means follow that the same question demands the same answer. The importance of the question lies in the fact that, in the early stages of the development of a new strain, 100 lbs. of its lint simply do not exist, for the cotton breeder has to multiply a new strain during three seasons in order to obtain even a few pounds of lint. Moreover, a cotton breeder grows a number of strains at one time; he has neither the time, nor the staff, nor the land available for growing large quantities of all his strains. At a certain stage, therefore, he cannot continue to multiply all of them; circumstances compel him to select some and to reject the others. Evidently his work will be very much facilitated if a reasonably accurate spinning test of his cotton can be made when only about 10 lbs. of lint of any given strain are available, and he will be correspondingly hampered if he is asked to provide at least 100 lbs. of lint for the spinning test.

For these reasons, one of the first investigations carried out at the Technological Laboratory was a comparison of the results obtained from samples of different weights. Six lots of each of the standard cottons were prepared weighing 100, 10, 5 lbs. (two lots), and 2 lbs. (two lots), and then each lot was put through the spinning plant as if it were a separate sample. These tests are described and the results given in Technological Bulletins, Nos. 2, 3, and 6, already referred to (p 222).

The subsequent analysis of these test results showed that in all respects, except strength and card-waste, the size of the sample made no difference to the results obtained. A correction-factor was obtained for the difference in card-waste; and the differences for the strengths of the 10-lb. samples were found to be negligible. And, most important of all, the conclusion finally reached on the basis of these very extensive tests was, that if the spinning tests had been confined to tests in duplicate on lots weighing only 5 lbs. each they would have led to accurate conclusions regarding the spinning capacities of the cottons. It was therefore concluded that the procedure adopted in the Technological Laboratory for testing small samples submitted by cotton breeders—viz., making spinning tests in duplicate on lots weighing only 5 lbs. each—was completely justified; certainly, there are now the strongest grounds for this conclusion so far as it applies to the range of counts possible with Indian cottons—*i.e.*, up to 40's counts.

TEMPERATURE AND HUMIDITY IN COTTON SPINNING.—It is evident that the spinning test should always assign the same spinning value to any given cotton. But the results obtained in spinning depend not only on the cotton, but also on many other factors—viz., the machinery employed (the speeds, settings, etc., at which it is run); the physical conditions—especially those of temperature and humidity—under which the various processes are carried out; and the human element. All these factors ought therefore to be kept constant. Every effort is made at the Technological Laboratory to see that disturbing effects due to the machinery and human factors are reduced to as small dimensions as possible; but disturbing effects may still arise from differences in the physical conditions under which the tests are carried out. It has been variously stated that the minimum humidity which should prevail during spinning is 50 per cent., 60 to 70 per cent., and occasionally 40 per cent., or even less. The matter has assumed importance at the Technological Laboratory owing to the desire to have as much latitude as possible in the physical conditions without detriment to the accuracy of the spinning tests. With the *Carrier* system of humidification installed in the laboratory it would be possible to maintain all the year round a temperature of 90° F. and a relative humidity of 70 per cent. But even with the ventilation which is afforded by the *Carrier* system, these conditions occasion much personal discomfort to the staff. It was primarily for this reason that tests were undertaken at the Technological Laboratory to determine the maximum latitude which could be allowed from these conditions in the spinning tests.

The tests were carried out under three sets of conditions:

1. *Medium-dry* conditions, involving an average temperature of 79° F. and a relative humidity which was occasionally lower than 40 per cent. and on the average was 46 per cent.

2. *Normal* conditions—*i.e.*, the conditions under which the working of the spinning laboratory is normally carried on, a temperature not less than 80° F. and the relative humidity not less than 60 per cent.

3. *Monsoon* conditions—viz., a temperature of 90° F. and a relative humidity of 70 per cent.

Observations were made as to the several conditions for (1) comfort in working, (2) workability of the material, (3) appearance of the yarn, (4) strength of the yarn.

The conclusions drawn from these tests were:

(1) For comfort, the normal conditions are more satisfactory than either of the extreme conditions.

(2) For workability of the material, the medium-dry conditions are not quite satisfactory in the card-room, whereas the normal and monsoon conditions are satisfactory throughout.

(3) The yarn spun under medium-dry conditions is the least satisfactory in appearance, and that spun under the monsoon conditions the most satisfactory, but these differences practically disappear when the yarn is conditioned.

(4) Within the limits of temperature and humidity within which these tests were carried out, it is impossible to lay down any hard-and-fast rule as to the conditions (medium-dry, normal, or monsoon) which give rise to the strongest yarns, the differences for the most part being inappreciable.

(5) In general, it may be taken that the processing of the material in cotton spinning and the quality of the spun yarn are not seriously affected by the spinning processes being carried out at relative humidities as low as 40 per cent.; but that, taking all things together, the normal conditions are probably best for carrying out cotton-spinning tests.

(6) Bombay conditions are practically ideal for the processing of the material in cotton spinning.

The Desirability of Marketing Cotton in a Clean Condition.—Indian cottons are commonly criticized not only on account of their short staple, but also on account of the large amount of dirt which they usually contain. With established markets in the present types of cotton, however, it is not easy to secure that a grower who gives special attention to marketing his cotton in a clean condition shall receive the extra payment to which the quality of his cotton entitles him. Yet, at the other end, the spinner has no desire to purchase dirt with his cotton merely for the sake of giving himself the trouble of separating the two. Hence the real problem lies in the market. With a view to throwing some light on the practical side of this matter, and with a view to getting the interested parties to co-operate in taking some action in removing this disability from which Indian cotton suffers, an investigation was carried out at the

Technological Laboratory to determine to what extent it is possible to improve the appearance of very dirty cottons by giving them extra cleaning in the blow-room. The usual methods were employed, a number of cottons being used and a large number of observations and tests being made on the yarn which was spun. The whole investigation included 3,600 lea tests and 7,200 single-thread tests.

The results show that three or four treatments in the Crighton opener, as compared with the normal two treatments, yield an increase of only about three-quarters per cent. in the total waste for each additional treatment; otherwise the extra treatment makes practically no difference either to the behaviour in spinning, or to the appearance of the yarn—including its evenness and neppiness—or to the strength of the yarn. The effect of additional scutching, like that of the Crighton opening, was comparatively insignificant.

The chief conclusions drawn were that: (1) So long as the material passes uniformly through the blow-room, repeated opening or scutching effects a slight improvement in cleaning without detriment to the strength of the yarn; and (2) once cotton containing foreign matter is pressed into bale form it may be very difficult, if not impossible, to remove the foreign matter completely—especially if it consists of fragments of seed-coat—so that the appearance and value of the yarn suffer accordingly. The second conclusion shows how important it is that cotton should be cleaned as far as possible at all stages prior to baling. This may be done by clean picking in the first instance, by cleaning of the *kapas* (seed-cotton) before ginning, or of the lint before pressing, by giving attention to the ginning, so that *kapas*, whole-seeds, cut-seeds, or fragments of seed-coat, are not allowed to pass through with the lint and so eventually spoil the yarn. But if clean picking and good ginning are to be worth while, the difference in market value between high and low grade cotton must be higher than is indicated by the difference in blow-room loss alone. And seeing that baling the cotton in a cleaner state ensures a direct saving represented by the difference in blow-room loss, as well as indirect savings on the incidental charges of freight, insurance, and storage—which are necessarily incurred on the extra foreign matter present in the cotton—and finally, that from the cleaner cotton it is possible to spin a yarn which is also cleaner and therefore able to command a higher price, it is clearly desirable that the cotton trade should offer every encouragement to the movement for securing cleaner cotton.

THE EFFECT OF DIFFERENT SPINDLE SPEEDS ON THE RESULTS OF SPINNING TESTS.—The investigation into the effect of increasing the spinning speed was undertaken because in 1927 it was desired to use higher spinning speeds in the cotton-spinning tests at the Technological Laboratory; the difficulty then arose that a change in the spinning speed might render invalid a comparison of results obtained before and after the date of the change unless it could be shown that the change in the speed makes no difference to the results of the tests. In a discussion of the whole subject it is pointed out that, from a millowner's point of view, increasing the spinning speed has to be considered in relation not only to the production, but also to (1) the mill structure, (2) the spinning machinery, (3) the material in spinning, and (4) the human element.

Eight standard Indian cottons were accordingly subjected to test; each of these was spun in duplicate lots into three different counts of yarn, at low speeds and high speeds. The "low" spindle speed was 8,600 r.p.m. for all counts, the "high" spindle speeds were 8,900 r.p.m. for 20's, 9,550 r.p.m. for 30's, and 9,950 r.p.m. for 40's counts. A record was maintained of the number of yarn breakages in the ring frame in each case; each yarn was classified for evenness and neppiness, and subjected to tests for counts, lea strength, ballistic strength, single-thread strength and extension, and twist. In all, 4,800 tests were made for lea strength and counts, 4,800 tests for ballistic strength and counts, 19,200 tests for single-thread strength and extension, and 9,600 tests for twist.

An analysis of the results shows that, within the comparatively narrow limits of these tests, the higher spinning speed makes no difference whatever to the number of ring-frame breakages, or to the strength, extension, evenness, and neppiness of the yarns. An examination of the minimum single-thread strength in relation to the calculated value for the maximum winding-on tension leads to the conclusion that breakages are to be attributed primarily to unevenness of the yarn, extending over an inch or two, rather than to neppiness or dirt in the yarn. It is concluded that, so long as the counts of yarn are well within the spinning capacity of the cotton, the results obtained at the high spinning speed are identical with those at the low spinning speed. Hence there is every justification for using the higher spindle speeds in the spinning tests on the standard Indian cottons. But if a cotton is being spun near its spinning limit, it is to be expected that an increase of spinning speed will cause an increase in the number of spinning breakages—both because of the greater unevenness of the finer count and also because of its greater weakness. Any factor contributing to unevenness of yarn should therefore be avoided. Excessive speed of machinery may lead to excessive vibration, and so to unevenness of yarn and more spinning breakages; thus there is a mechanical limit to the speed of the ring frame, although this limit will of course be higher for machinery in good condition. But if the counts of yarn being spun are well within the capacity of the cotton there is no disadvantage in spinning at the highest possible speed, for an increased production is then obtained without any sacrifice of the good qualities of the yarn.

THE EFFECT OF USING UNBALANCED DRAFTS INSTEAD OF BALANCED DRAFTS IN THE SPINNING PREPARATION FOR SPINNING TESTS.—This investigation became necessary because it is the practice at the Technological Laboratory, for speed and convenience of working, to spin three counts of yarn (20's, 30's, and 40's) from a single set of rovings. It is commonly believed that the drafts in the sequence of spinning preparation machines must be properly balanced, yet from the recommendations for drafts made by various authors it is clear that some flexibility in the co-ordination of drafts in the different machines must be regarded as permissible; the whole question really turns on where the limits are to be set. In order, therefore, to test the validity of the present procedure at the Technological Laboratory, experiments were carried out in parallel series on eight standard Indian cottons displaying considerable differences between one another; drafts of 4, 5, 6·6, and 8·6 were used for 20's, 30's, and 40's counts respectively in the unbalanced draft series, and drafts of 5·3, 6·2, and 6·9 for 20's, 30's, and 40's counts respectively in the balanced draft series. Four lots of each cotton were prepared, two lots being spun into three different counts of yarn according to each scheme of drafts; suitable drafts were given in the various preparation machines in the two series. In all 5,400 tests were made for lea strength and counts, 10,800 tests for single-thread strength and extension, and 10,800 tests for twist.

An analysis of the results shows that the difference in the system of drafting makes no practical difference to the number of breakages in the ring frame, or to the evenness, neppiness, strength, and extension of the yarn. For one of the cottons—C.A. 9—results were at first obtained which appeared to indicate that the unbalanced draft system yielded stronger yarn than the balanced draft system at high and low counts, and yarns of equal strength in the 30's counts, for which the drafts were the same on the two systems. A repetition of the tests on this cotton indicated that the differences in question were not due to some specific character of the cotton, but that they must be attributed to sampling errors in the selection of the cotton for the spinning tests.

It is concluded from these tests that a comparatively wide variation is possible in the series of drafts used in the spinning tests without affecting the results to any appreciable extent, and that the usual procedure at the Technological Laboratory of spinning the three different counts from one set of rovings is therefore completely justified.

Received December, 1928.

INDIAN COTTON: THE WEBS OF DACCA

We reproduce here another article from the *Illustrated London News* of October 20, 1855, the discovery of which we owe, like that of the article reproduced in our number of last October, to Mr. Bayard Dixon.

The processes described and figured here are now to a great extent extinct or dying, being unable to hold their ground against cheap mass production; but the article is worthy of being read by spinners and weavers (to say nothing of others), and more especially by those engaged in the designing of machinery, who may find in these descriptions some hints that are worth consideration; for processes that could spin Indian cotton to 320's (or 480's), and weave fine Dacca muslins therefrom, are not to be lightly disregarded.

To this branch of ingenious manufacture a new interest has been attached, by the display of several beautiful specimens in the Paris Universal Exhibition.

The illustrations indicate the mode of preparation of the raw material, and the several processes of manufacture of the finer sorts of Indian muslin, some of which are woven from threads of such extraordinary delicacy, that a single pound of cotton is spun for it into a length of 250 miles; and with all our genius of invention, our wonderful machinery, and extraordinary skill, we have never yet been able to equal the muslins of Dacca, of which Tavernier says, " they are so fine that you can hardly feel them in your hand." An English writer of the seventeenth century, speaking contemptuously of them, termed them " the shadow of a commodity "; but they have been called by those of higher taste, who looked at their exquisite delicacy and evenness with wonder, " webs of woven air."

The general idea as to this wonderful manufacture is, that it is produced almost at random, and with the rudest tools—that the Indian is guided by a kind of instinct in its make, and is but a rough and careless-fingered worker. We are told of the weaver cleaning his cotton with a piece of fish-bone, using as a spindle a hollow reed, hanging up his loom by a river side between two trees, digging a hole in the ground for his legs, and there weaving forth those moon cloud webs that queens of old were proud to wear.

There is some truth in the description, but none in representing the Hindoo as a manufacturer at random. In his case, as in every other, the excellence is attained by a minute attention to every detail in the preparation of his material, and of all circumstances influencing its condition during the process of manufacture—an amount of knowledge, no doubt, arrived at slowly, but still attained to ages ago; for these muslins of the East are mentioned amongst the earliest articles of commerce; and in one of the hymns of the Rig-Veda, dated fifteen centuries before our era, there is reference to cotton in the loom. Nor is it strange that the native Indians should, by practice, from generation to generation, have acquired surpassing skill in the manufacture of a material indigenous to their soil, and the fabrics of which were especially suited to their climate. Speaking of India, Herodotus says, " the wild trees in that country bear fleeces as their fruit, surpassing those of sheep in beauty and excellence, and the Indians use cloth made from those trees."

KNOWLEDGE OF THE QUALITIES OF COTTON.

The cotton from which the Hindoos weave their finest muslins is of inferior quality. The best-informed Manchester manufacturers state that all Indian is coarse, short in staple, and unfitted for the fine spinning for which American Sea Island cotton is alone employed in this country. The finest American cotton is cultivated with utmost care, and the best selected for the finest English manufacture.

The native Indian, on the contrary, is but a careless cultivator of cotton, and neglectful of attention in picking and preservation, which would save much after-labour. He is, however, thoroughly well acquainted with the qualities of the different kinds, and makes up for indifferent saving by a profusion of labour and pains in the after-preparation of the material. He knows that the thread made of cotton grown to the east of Dacca must be used in the very season it is grown or it will not swell in bleaching; and this swelling constitutes his distinction between the best and inferior cotton; and for spinning with the fingers the short fibre is as suitable as is the long for machinery.

PROCESS OF CLEANING, PICKING, AND CARDING.

As the cotton is not cleanly picked in the field, it is first necessary to pick out carefully with the fingers all fragments of the leaves or bracts, stalks, and capsules. The next process, previous even to the separation of the seeds, is a kind of carding to which the seed-cotton is subjected. For this purpose the Hindoos of Dacca make use of the jaw-bone of a fish, one of the *Siluroïdæ*. The teeth of this fish, being very numerous, closely set, and recurved like those of our pike, act as a fine comb in removing the loose and coarse fibres of the cotton, as well as minute particles of earthy or any other extraneous matter. (Fig. 1.)

BOWING.

The next process is that of *bowing* (Fig. 2), which has been so named from a *bow* being the instrument employed, and which has given its name to one kind, the *bowed* Georgian cotton, though the instrument is not used in the present day in America. It consists of a large bow, which is suspended to the roof of a room, often to the string of another bow. The string, while in contact with the cotton, being struck with a conical-headed mallet, the cotton, by its vibration, flies about in a light fleecy cloud, and is thus separated from dust and dirt. This instrument is still in use in some of our manufactories —for instance, in hat-making.

But the cotton for the fine Dacca muslins is bowed or teased with a bow of more delicate construction, as it consists of a piece of bamboo, with two elastic slips of the same useful material slipped into its two ends, and strung with a cord made of catgut, morga silk, or of plantain or ratan fibres twisted together. The bamboo slips are movable within the centre piece, and according as they are drawn out, or pushed back, so is the tension of the cord increased or diminished. The whole, being of a size to be held in the hand, can easily be managed.

SPINNING.

The cotton, by the aid of this instrument, being brought to the state of a fine downy fleece, is then "spread out and lapped round a thick wooden roller.' This being removed, the cotton is pressed between two flat boards, then rolled round a piece of lacquered reed about the size of a quill, and, lastly, wrapped in the smooth soft skin of the *Cuchia* fish, and is so preserved from dust or soil whilst it is held in the hand during the process of spinning.

The spinning of the fine yarn is entirely performed by women, usually under thirty years of age, and it is to their delicate organisation and exquisite sensibility of touch that is due the inimitable specimens of their skill.

The spinning apparatus, which is usually contained in a small flat work-basket, not unlike the *colothiers* of the ancients, comprises the cylindrical roll of cotton, a delicate iron spindle, a piece of shell embedded in clay, and a little hollow stone containing chalk-like powder, to which the spinner occasionally applies her fingers (Fig. 3). The spindle is not much thicker than a stout needle, and has attached to it, near its lower joint, a small ball of unbaked clay, which gives it sufficient weight in turning. This rests in the hollow of the piece of shell, and she turns the spindle between the finger and thumb of one hand, whilst she at the same time draws out the single filaments from the roll of cotton held in the other hand, and twists them into yarn upon the spindle; and, to obtain the requisite moisture of air, it is sometimes necessary, the thermometer being 82, to spin over water.

For ordinary purposes the cotton, instead of the above-described carding, is sometimes thrashed—that is, spread out upon an outstretched apron of coarse cloth, and beaten with switches, when the seed, etc., fall through. Instead of the primitive mode of pulling the cotton from the seed to which it adheres, the cotton is placed on a board and an iron roller moved backwards and forwards over it either by the hand or foot (see Fig. 4); thus the fibres are separated without the seeds being crushed. The foot-roller is used in the southern Mahratta country, and the hand-roller in Bengal; but generally all over India they use the *charka* or cotton-cleaning machine, formed of two cylinders kept in close opposition, and moved upon each other by their ends being formed on the principle of the Archimedean screw; the instrument, though usually clumsily made, answers its purpose well; the cotton is drawn between the cylinders, the seeds unable to pass through are separated and fall down, and the fibre is not injured.

The coarse kind of cotton which is grown in the hills near Dacca, and called *Bhoga* cotton, is used in the manufacture of thread for coarse fabrics. This is separated from its seeds by the common charka, or hand-gin, and the wool is *bowed* in the usual manner. It is then spun into thread by the common spinning-wheel, which is like the old *wool* wheel, called also big wheel from the size of its wheel. But the Hindoo wheel, though apparently more rude, has advantages in working which readily become obvious in changing its form: thus, for instance, the rim being formed of string instead of wood or metal, gives a certain degree of tenacity as well as of elasticity. While the straight spindle is set in motion by this wheel, the unfinished yarn or roving is held in a sloping position to the spindle, so that at every turn of the spindle the yarn slips off its point and gets twisted without getting wound upon it.

PREPARATION OF YARNS BY THE WEAVER.

Winding.—The yarn obtained for the weaver is first steeped in water. Being usually wound on small pieces of hollow wood, a piece of stick is first passed through these, and then fixed in the cleft end of a piece of bamboo. The weaver, holding the latter between his toes, draws off the yarn from the reel, which revolves upon the stick passed through it, and winds it upon the reel (see Fig. 5), which he holds in the other hand, and whirls round in a small cup of smooth cocoanut-shell. When the yarn is in the form of a skein, it is put upon a small wheel of fine slips of bamboo and thread, and then wound up upon the reel (see Fig. 6). The finest thread is separated for the *woof*, and the rest for the *warp*. The latter is steeped for several days in water which is frequently changed, and is then reeled, and dried. Skeins of a convenient size are then wound up, again steeped in water, and tightly twisted between two sticks (see Fig. 7); they are again dried in the sun, untwisted, and put into water mixed with charcoal-powder for two days, then rinsed in clean water, and hung up to dry in the shade. Each skein is again reeled, steeped in water for one night, and is next day opened up and spread over a flat board, smoothed down with the hand, and then rubbed over with a paste, or size, made of rice and a small quantity of lime mixed with water. The skeins are then reeled upon large reels, the threads widely separated, and then dried in the sun. The thread is again reeled and sorted, generally into three qualities. The yarn for the warp of striped or chequered fabrics is prepared by twisting a certain number of threads together—viz., two for each stripe of the *Doorea* and four for that of the *Charkana* muslins. The yarn for the woof is not prepared till two days previous to the time it is required for weaving. It is steeped in water, rinsed, wound on large reels, and then lightly sized with rice-paste, and again reeled and left to dry in the shade, and used daily.

Warping (Fig. 8).—The thread employed in weaving is well known to be of two kinds: that which stretches lengthwise being called the *warp*, and is usually stronger, harder, and more twisted than that which runs across, and is called the *woof* or *weft*, and is softer and less twisted than the other. The yarn being properly prepared, the next step is to arrange the threads which are to constitute the warp alongside of each other in one parallel plane. The Hindoo performs the operation in the open air, first fixing four short bamboo posts into the ground at measured distances, according to the intended length of the cloth. He then places between them several pairs of rods, about 4 feet apart, in two parallel rows. "The weaver, holding a small wheel of warp-yarn in each hand, passes the latter over one of the posts, and then walks along the rows, laying down two threads, and crossing them (by crossing his hands between each pair of rods) until he comes to the post at the opposite extremity." He then retraces his steps backwards and forwards as often as there are threads of the warp to be laid down. The small reels on which the warp-yarn is wound are made of fine splits of bamboo and thread, and are each attached at right angles to a piece of stick, forming an arm, at the end of which there is a ring of coarse glass, through which the yarn runs. In striped and chequered muslins, two pairs of hand-reels, one with single and the other with twisted yarns, are used alternately for the warps. This is the simple form of effecting warping, for which, in Europe, either the warping-frame or warping-mill, with its heck-box, is required to divide the warp-thread into the lease on the two alternate sets, one for each heald.

Applying the Reed to the Warp, or Drawing (Fig. 9).—This part of the process is by the Hindoo women performed either immediately after the warping, or sometimes not until after that of the *beaming*. The *reed* is so called from having been originally formed of split reeds, but by the Hindoo weaver it is generally formed of fine splits of bamboo, firmly fixed between ribs of split cane. Mr. Taylor states that the finest reeds used in the Dacca looms contain only 2,800 dwts. in a space of 40 inches in length. The warp, being folded up in the form of a roll, is suspended from the roof of the weaver's hut, with one end of it unfolded, and hanging down to within a foot or two from the ground. The reed is then suspended by two slight cords to the warp-roll and loose rods, and hangs in front of the unfolded portion of the warp. One weaver sits in front of the reed and another workman on the other side of the reed. The end loops of the warp having been cut with a knife, the weaver in front passes an iron wire or sling hook through the first division of the reed to the other workman, and the ends of the two outermost threads being twisted upon it by him, it is drawn back, and the thread thus brought through. Thus two threads are drawn through each of the divisions of the reed in succession. The ends of the threads are then gathered up in bunches of five or six, and knotted; a small bamboo is then passed through the loops formed by the knots.

Beaming, or Applying the Warp to the End Roll of the Loom (Fig. 10).—Like the warping, performed in the open air. A workman holds the warp folded upon the reed in the form of a bundle. The end of it being unfolded, a thin slip of bamboo is passed through it,

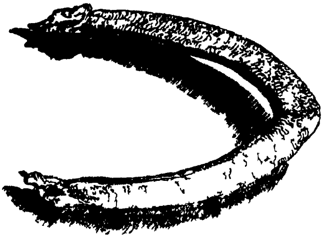


FIG. 1. COTTON CARDER

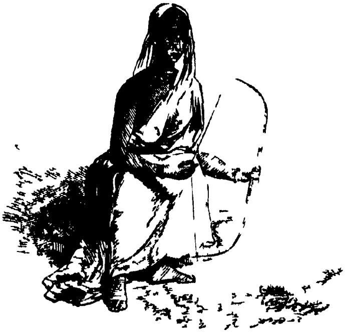


FIG. 2. THE BOW

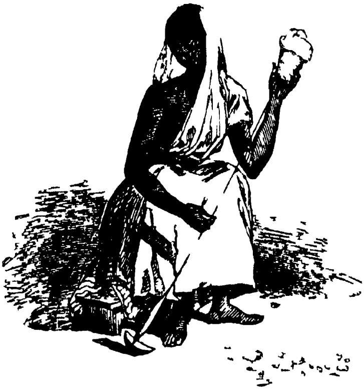


FIG. SPINNING

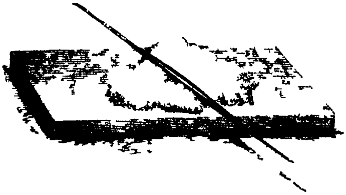


FIG. 4. COTTON ROLLER

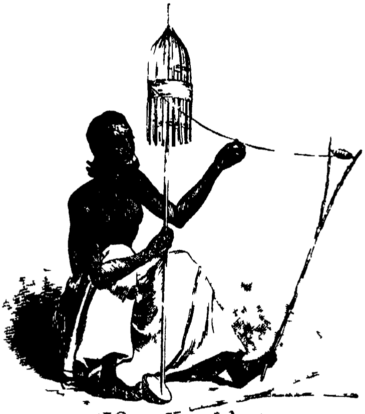


FIG. 5. YARN WINDER

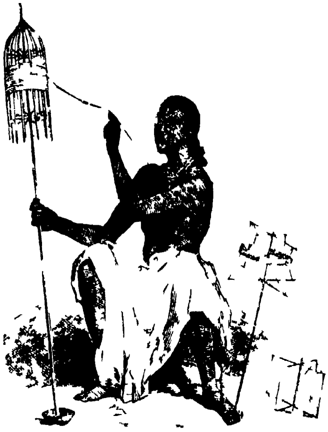


FIG. 6. YARN WINDER

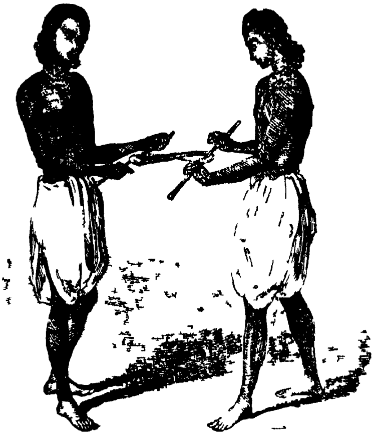
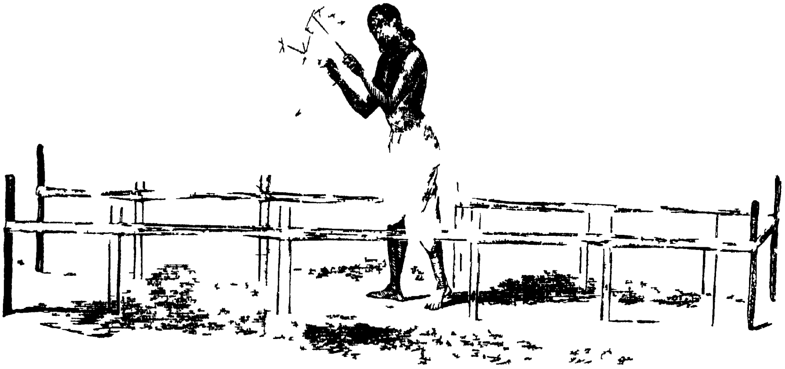
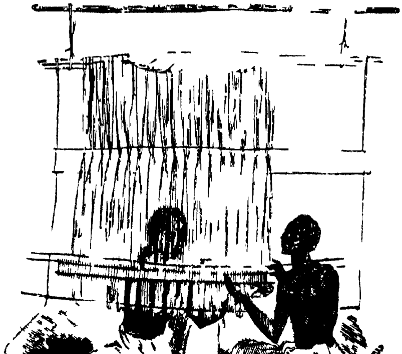


Fig. 7 Twisting the Thread





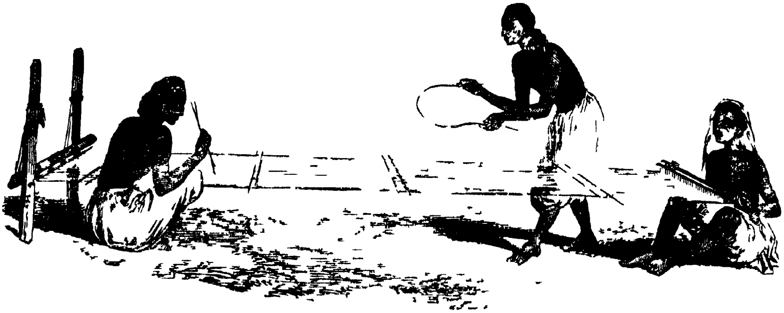


Fig. 10. Beaming.

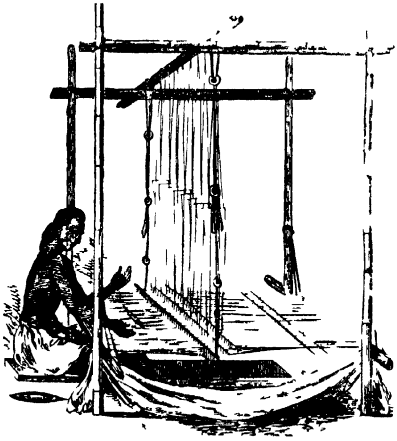


Fig. 11. The Loom: Weaving.

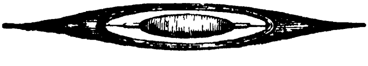


Fig. 12. The Shuttle.

and it is then received into a longitudinal groove in the end roll (yard-beam) and fastened to it with pieces of string. The roll rests in two loops of cords attached to two posts, and is turned round with a winch. The warp-threads are next arranged, and much in the same way as in this country, adopted probably from the East. The outermost thread being placed according to the intended breadth of the cloth, a portion of the warp is unfolded and kept on the stretch by the person holding the bundle, while two workmen proceed to arrange the threads in the middle. This they do with a small piece of cane, softened and beaten out at one end into the form of a brush (like the separator or ravel), and then gently tap them with an elastic cane, held in the form of a bow, to bring them into a state of parallelism. The portion of the warp thus arranged is carefully wound upon the end roll. Another portion is then unrolled and similarly prepared.

Preparing the Healds or Heddles.—For this purpose a portion of the warp behind the reel is unfolded and stretched out, when a broad piece of bamboo is placed edgewise between the threads of the warp, in order that the weaver may have sufficient room to form the loop of the heddles. These are formed of reddish-coloured twine, which is passed between the separated threads of the warp to the opposite side and is fastened to a cane, to which is attached an oval piece of wood of about 8 inches in length. The weaver then dips two fingers between the outermost thread of the warp and the one next to it, and brings up a fold or loop of the coloured string, which passes upon the inside of the oval piece of wood, and is crossed upon the cane above. The same process is repeated between every two threads of the warp, the cane and oval piece of wood being gradually moved across the warp as the work proceeds. Two sets of loops are formed on each side of the warp; when those of one side are finished, the warp is removed from the post, reversed, and stretched out as before, and the process of the other side is repeated. The canes on which the loops are crossed are fastened by strings to four small bamboo rods, the two upper ones being attached, when placed on the loom, to the strings of the heddles, and the two lower ones to the weights of the treadles.

The Loom and Weaving (Fig. 11).—In most accounts of Indian weaving the weaver is described as suspending his loom between two trees, and allowing his treadles to fall into a hole in the ground, into which he inserts his legs and feet. But in Dacca the loom is horizontal, and always erected under a roof—either that of the weaver's house, or that of the shed built for the purpose. Four bamboo posts are firmly fixed into the ground, and connected above by two side-pieces. On these is supported a transverse rod, to which the sling of the lay or batten and the balances of the heddles are attached. The warp wound on the end roll (or yarn beam), and having reed and heddles attached to it, is brought to the loom and fixed to the breast roll (or cloth beam) by a small slip of bamboo, which is passed through the loops of the warp, and received into a longitudinal groove in the beam. The end and breast rolls are attached to the four standards, and are turned round with a winch. The lay or batten consists of two broad flat pieces of wood, grooved on their inner edges for the reception of the reed, which is fixed in its place by iron or wooden pins passed through the ends of the lay. It is suspended from a transverse rod above by slings passing through several pieces of sawed shell. By altering the distance between these segments of shell, which is done by lengthening or shortening the intermediate slings, the range of motion of the lay is increased or diminished. The extent of this range of motion regulates, in a great measure, the degree of force which is applied to the weft in weaving. The proper adjustment of this part of the apparatus is considered by the weavers as one of the nicest operations connected with the loom. The balances of the heddles being suspended to the transverse rod, the treadles, made of pieces of bamboo, are contained in a pit dug in the ground.

The Shuttle (Fig. 12) is made of light wood of the betel-nut palm (*Areca catechu*), and has spear-shaped iron points. It is from 10 to 14 inches in length, and three-quarters of an inch in breadth, and weighs about 2 ounces. It has a long open space in its centre, in which is longitudinally placed a movable iron wire, upon which the reed of the weft thread revolves, passing, as it is thrown off, through an eye in the side of the shuttle. The temple or instrument for keeping the cloth on the stretch during the process of weaving is formed of two rods connected with a cord and armed at their outer ends with two brass hooks or pins, which are inserted into the edges of the cloth on its under surface. The loom being thus adjusted, we see that, however rude it may appear, it is complete in all its parts; and the weaver, being furnished with the cobweb-like yarn, displays his unrivalled skill in performing the various delicate operations necessary to the weaving of these webs of woven air. To lessen friction on the two threads of the warp during the process of weaving, the shuttle, reed, and lay are all oiled. When 10 or 12 inches of the cloth are finished, they are sprinkled with lime-water, to preserve them from insects, and then rolled upon the cloth beam, and another portion of yarn uncovered. Sometimes it is necessary to place beneath the extended yarns of the warp a few shallow vessels of water, in order that by the evaporation the threads may be kept moist and prevented from breaking. The time required for the manufacture of a piece of muslin necessarily varies according to the quality, and the expertness of the weaver. A half-piece (ten yards in length by one yard in breadth) of the finest muslin, costing seventy to eighty rupees, cannot be manufactured in less than five or six months. A whole piece of Navainpore jehazy muslin, costing two rupees, can be made in the course of eight days. In weaving flowered or jamdanee muslins, two weavers sit at the loom. They place the pattern, drawn upon paper, below the warp, and range along the track of the woof a number of cut threads, equal to the flowers or parts of the design intended to be made. They then, with two small, fine-pointed bamboo sticks, draw each of these threads between as many threads of the warp as may be equal to the width of the figure which is to be formed; when all the threads have been brought between the warp, they are drawn close by a stroke of the lay, and the shuttle is passed through the thread, and the weft driven home.

COTTON DISEASES IN UGANDA, 1926-1928

BY

C. G. HANSFORD, M.A.,
Government Mycologist.

PART III.

X. MECHANICAL INJURIES, ETC., IN COTTON BOLLS.

FROM time to time a number of abnormalities have been observed on cotton bolls in Uganda. Some of these are apparently dependent on weather conditions, being much more prevalent in wet seasons, while others are found to be of more general occurrence every season. During the course of the experimental work carried out by the writer during the past two cotton seasons, the following notes have been accumulated on these abnormalities, and are given here to complete the present survey of cotton boll diseases in Uganda:

(*a*) A very common abnormality is the development of asymmetric bolls, with one or more locks partially aborted, the seeds apparently unfertilized, and the lint undeveloped. In other bolls these abnormal locks may contain only one or two normally developed seeds, the rest apparently not fertilized. No evidence of bacterial or fungus invasion of the majority of such bolls has been found, and apparently the abnormality is merely the result of the unequal distribution of the fertilized seeds among the three or four locks of the boll.

(*b*) Some bolls have been found in which a very abnormal development or even proliferation of the placentæ has taken place, resulting in a thick fleshy core. No pathogenic organism has been found, and at present no evidence is available to explain such abnormalities.

(*c*) A common external abnormality of cotton bolls here is the development of small corky scabs on the surface of the boll walls. These are usually approximately circular in outline and hard in texture, varying in size from $\frac{1}{5}$ to 1 or 1·5 mm. in diameter. The surface is often rugose and furrowed, and very slightly raised above the general level of the boll wall. The scabs are usually dry and dark-brown in colour.

In such scabs the writer has been unable to find any parasitic organism, though a number of saprophytic fungi and bacteria have been isolated from the surface. None of these organisms has reproduced the scab when inoculated on to healthy bolls, even when the surface of the boll is injured. On the other hand, similar scabs have been formed occasionally by pricking the epidermis and sub-epidermal layers with a very fine sterile needle, not penetrating into the deeper tissues of the boll wall. Though these scabs are produced in only approximately 20 per cent. of the total number of bolls thus treated, the writer is of the opinion that these scabs in the field are the result of similar injury caused to the external layers of the boll wall by small sucking insects. They are not associated with the attack of adult *Dysdercus*, which causes an entirely different form of injury.

(*d*) In very moist weather the corky scabs mentioned in the preceding paragraph become infected by a greyish-white bacterium, which invades the deeper cracks in the corky tissues, and on reaching the living cells below causes these to proliferate, resulting in the raising of the remains of the corky scab by a loose aggregation of large, almost spherical, thin-walled hyaline cells, with the bacterial slime in the intercellular spaces. Such spots macroscopically show a raised slimy mass of loose tissue, which is often covered with a wet shiny exudation, consisting largely of bacteria.

These spots have occasionally been reproduced by the writer by scratching the surface of the boll wall with a fine needle and spraying with a culture of the bacterium isolated from natural infections. Successful inoculations are very difficult to produce and, as indicated above, it is most probable that special weather or temperature conditions are a necessary factor in development. In the field this disease was found most frequent in the Eastern Provinces after the very wet weather of the 1926-27 cotton season.

(*e*) *Internal Proliferation of the Boll Walls.*—This proliferation was shown by Nowell (*loc. cit.*) to be the result of *Dysdercus* attack, and this has been confirmed in the experimental work of the present writer. After the puncturing of the boll wall by this insect, the middle layers of the wall tissue are stimulated and the cells rapidly divide, giving a loose mass of large spherical cells, which force their way through the minute aperture left by the proboscis of the insect in the tough internal layer of the boll wall. This aperture is enlarged considerably by the pressure of the new tissues, and the result is a mass of hyaline, or in late stages slightly yellow, cells, up to 4 or 5 mm. in diameter, on the inside surface of the boll wall. Such proliferations are a sure index of the attack of *Dysdercus*, and serve as a means of counting the actual number of punctures made on each boll. Here it may be noted that infections of *Nematospora* are almost always associated with such proliferations, and, in fact, this formed the original evidence on which the connection between *Dysdercus* attack and infection by *Nematospora* was first elucidated by Nowell (*loc. cit.*).

This proliferation caused by *Dysdercus* has been reproduced by the present writer by using a very fine sterile needle to penetrate just through the boll wall. If the hole made is too large no proliferation occurs, and it appears that the needle must be fine enough to allow the aperture made in the outer layers of the wall to heal up more or less completely by the thickening of the walls of cells adjacent to the site of injury. Examination of old punctures of *Dysdercus* shows that superficially almost no sign of the puncture is visible. Occasionally a minute dark spot is just visible. Under the microscope the cells adjacent to the puncture in the outer layers of the wall have thickened walls, and the aperture is almost, if not completely, closed up by these cells.

No organisms have been found in the wall tissues around the insect punctures, nor among the proliferated tissue. The internal *Nematospora* attack first develops on the surface of the lint beneath the proliferating tissue at the site of the puncture. The writer has obtained no evidence of the presence of *Nematospora* in the tissues of the wall nor among the proliferating cells on the interior surface of the wall. In the light of all evidence available, the writer is unable to accept any theory of the growth of *Nematospora* through the minute aperture left in the boll wall by the insect after withdrawal of its proboscis, and is inclined to the view that spores of the fungus are actually conveyed by the insect into the interior of the boll, where they subsequently develop.

In connection with the proliferation caused by *Dysdercus* it is worthy of note that when older bolls are attacked by this insect the characteristic proliferation may not develop. In such cases the puncture is visible as a dark-brown speck or a minute patch of water-soaked tissue on the interior surface of the boll. Frequently a yellow discoloration of the interior wall surface develops, and may extend throughout the lock affected, even in the absence of *Nematospora* infection. In the latter case, however, the lint is not affected, and remains pure white in colour; but where *Nematospora* has been introduced by the insect, the lint is stained yellow, due to the interaction of host and fungus. The yellow pigment is apparently developed by the host plant as a result of the stimulus of the parasite, and from the general observations it would appear that this yellow pigment is developed in the internal tissues of the cotton boll as the result of injury either of mechanical or parasitic origin.

(*f*) Artificial injury to cotton bolls by means of a needle or hypodermic syringe penetrating inside the lint cavities often results in malformation of the lock affected, or, in extreme cases, of the whole boll. In young bolls the seeds may be partially or entirely prevented from developing, and similarly with the lint. The internal layers of the boll wall may or may not proliferate; the partition of the boll and the placenta may develop abnormalities and malformation. The interior surface of the boll wall in one or more locks may be discoloured, appearing dark-yellow to brown, with minute black flecks. The abnormalities may develop in the absence of bacteria and fungi introduced on the instrument, though commonly such organisms are carried through the boll wall and develop in the lint cavity.

XI. INTERNAL FLORA OF COTTON SEED IN UGANDA.

From the various samples of cotton seed examined by the writer during the past two years, the following organisms have been isolated: *Nematospora gossypii*, Ashby and Nowell; *Fusarium moniliforme*, Sheld.; *Fusarium sporotrichioides*. Sherb.; *Fusarium acuminatum*, B. and Rav; *Fusarium anguioides*, Sherb.; *Fusarium diversisporium*, Sherb.; *Cladosporium herbarum*, Link; *Alternaria* sp; *Bacterium malvacearum*. E.F.S.; *Bacterium* sp. yellow, identical with cultures AQ1, AQ2 isolated from cotton bolls; *Chætomium* sp; *Aspergillus tamari*; *Aspergillus sydowi*; 2 spp. of *Penicillium*; *Nigrospora oryzæ*; *Cephalosporium* sp.

Of these organisms *Aspergillus* spp., *Penicillium* spp., *Cladosporium*, *Nigrospora*, *Cephalosporium*, *Chætomium*, *Alternaria*, and *Fusarium* spp. (except *F. moniliforme*) occurred only in seed showing evidence of damage to the testa. Under such conditions a large variety of organisms are evidently capable of making their way into the interior of the seed, and many set up a disorganization of the cotyledons and embryo. In no case were any of those fungi found in undamaged seed. They apparently enter the seed after the latter has been damaged in ginning, or during the storage period.

The remaining fungi and bacteria—namely, *Nematospora*, *Fusarium moniliforme*, and the bacteria—are found in seed showing no evidence of superficial damage to the testa. The methods by which such fungi and bacteria are able to enter the seeds still remain obscure.

It is doubtful whether these fungi and bacteria enter the seed while the latter is still only partially developed and enclosed in the immature boll. All evidence available to the writer indicates that, where such seed is penetrated by these organisms, it is completely rotted before the opening of the bolls, and also the lint in such affected bolls is of such a quality that it would seldom be collected for the ginnery, but merely left in the fields.

The amount of internal infection in cotton seed varies greatly, and may be as high as 20 to 25 per cent. in particularly bad samples. Usually, however, it is very small, as indicated by germination tests.

Seed infected by *Nematospora* very rarely germinates, as during the softening of the interior of the seed during the preliminary stage of germination the fungus grows to such an extent as to completely disorganize the contents of the seed.

On the other hand, seed infected internally with *Fusarium moniliforme* readily germinates, and the seedlings remain healthy. On one experiment, seed known to be infected internally was sterilized externally and germinated in litre flasks with a layer of sterile agar at the bottom. A number of these seeds gave pure cultures of *F. moniliforme*, but the seedlings grew healthy until they were discarded on account of the flasks being too small to accommodate them. Those seeds which gave cultures of *Nematospora*, when similarly treated, proved incapable of germination, and when examined three weeks after sowing were completely rotten inside.

Seed infected with *B. malvacearum* and the other yellow bacteria may or may not germinate, depending on the site and extent of the infection. Where infection is limited to small spots on the cotyledons, germination takes place in the normal manner, the spots being visible on the cotyledons as these emerge from the soil. Subsequently from these spots the disease may, under suitable climatic conditions, spread to the young leaves as these are formed by the seedlings. In other cases the radicle is infected by the bacterium while still enclosed within the seed, and such seeds do not germinate.

As pointed out above, it appears doubtful whether internal infection of the seed with these fungi and bacteria takes place in the unopened bolls. In order to explain the high infection noted in some samples of cotton seed, it would appear necessary for infection to take place subsequently to the opening of the bolls. In these samples the lint must have appeared normal, as otherwise the seed would not have reached the ginneries in quantity, and for this reason alone it is unlikely that infection took place prior to the opening of the bolls, for if this had happened the lint would at least have been badly stained.

In Uganda, after the cotton bolls have opened they are frequently infested with *Dysdercus*, both nymphs and adults, and *Oxycarenus*. It is possible that either of these can introduce the fungi and bacteria in question into the interior of the seed, and no external injury would be apparent. Also, after ginning, the heaps of cotton seed accumulating at the ginneries are covered with thousands of *Dysdercus*, which may then introduce *Nematospora*. The case of seed attacked by *B. malvacearum* and *F. moniliforme* is not quite so clear as that of *Nematospora*. There is not as well defined an association between these organisms and the cotton insects as in the case of *Nematospora*.

A considerable proportion, at least 50 per cent. of the seeds internally infected with *B. malvacearum* are affected in the radicle—that is, at the micropylar end of the seed. In the case of those seeds affected only in the cotyledons, these infections appear to be quite independent of the micropyle. On examination of such seed it is found that the various individual infections on the cotyledons which, after germination, appear independent of each other are really the result of a single infection having spread through the tight folds of the cotyledon while still enclosed in the seed. Usually only a single infection is found in each seed attacked. Excluding those seeds affected in the radicle, presumably by way of the micropyle, it appears that in all probability the infections on the cotyledons are to be associated with insect punctures on the mature seed, either before or after ginning. Experimental evidence in support of these views is not yet available.

The case of *F. moniliforme* as an internal parasite of cotton seed is still more obscure, as, except in those seeds very extensively infected and partially rotted by the fungus, no damage to the power of germination is apparent. Also, healthy cotton seed germinates normally in a culture of this fungus, and the seedlings are apparently immune to its attack. Its method of entry into the seed and the conditions under which it is able to attack the internal tissues of the seed have not yet been worked out.

* * * * *

In conclusion I have to thank Mr. G. W. Nye, Cotton Botanist, Uganda, for his criticisms and remarks on the paper, and for information he has supplied me; also Mr. G. L. R. Hancock, Assistant Entomologist, who has helped considerably with the experimental work with *Dysdercus*.

NOTE ON ADVENTITIOUS BUD FORMATION IN COTTON

BY

F. E. KENCHINGTON

OWING to the prevailing custom in almost all modern cultivations of treating the cotton crop strictly as an annual, and enforcing a cutting-out and a blank period, one tends to think of cotton more as an herbaceous, annual plant, and to forget its natural perennial habit and more shrubby nature. That it can be budded, grafted in several fashions, propagated by cuttings,* cut back and ratooned, lifted and hoeled in, are properties which pertain more characteristically and universally to woody perennials than to herbaceous annuals. These uncommon practices, although in the nature of horticultural tricks of no practical interest to the commercial grower, are capable of many useful applications by the plant-pathologist and plant-breeder. A property of this sort recently observed in the cotton plant, and new to the writer, is that of adventitious bud formation from the roots.

There are characteristically two buds (one axillary and one extra-axillary) in each node-unit of the plant, of which often one and sometimes both lie dormant, visible only to careful examination and dissection. These may be awakened into growth later by wound response or other cause.

In the seasons 1926-27 and 1927-28 cases have been observed here at Shambat in the Northern Sudan where plants have been cut through below the cotyledonary nodes (verified by careful examination), and even below ground level: the cut roots after lying dormant for some time in the soil have later produced protruding, blister-like cushions of white, soft, parenchymatous tissue. Upon these, true adventitious buds have formed and have given rise to normal aerial shoots, appearing some two to four months after the cutting out. These cushions of tissue appear characteristically, not on the cut end of the main axis as callus tissue would, but extruded through its cortex in a manner suggesting their possible origin from modified lenticels. They occur in that zone where large conspicuous lenticels are common; their pale colour and soft texture contrast strongly with the old cortex, and resemble the appearances observed in the

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* Harland, 1927, EMPIRE COTT. GR. REV., iv., 1, p. 53.

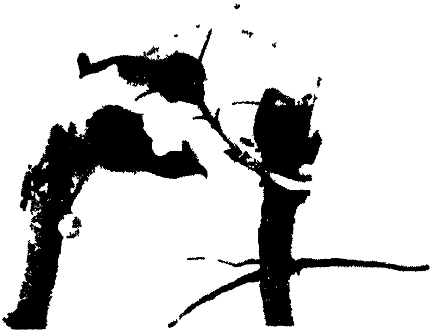

Fig. 1. Sakel Cotton

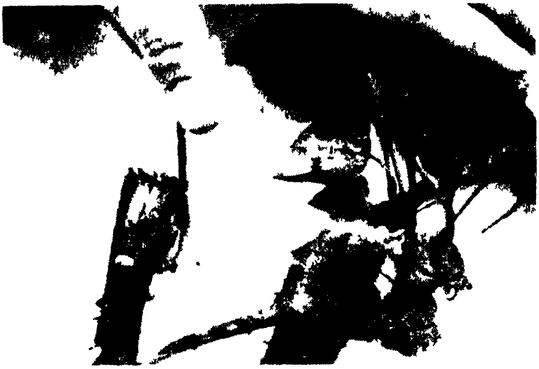

Fig. 2. Sea Island Cotton

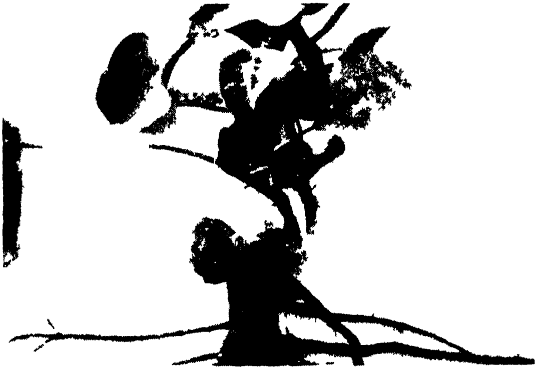

Fig. 3. Arboreum Cotton

Showing Adventitious Bud Formation in Cotton

very large white over-developed lenticels of plants which have grown under very wet conditions, or which have been pulled up and kept alive for some days with their roots in water.

In the experimental cultivation of cotton plants in boxes, it is our custom to sow a number of seeds in each box as an insurance against failures or damage. These are later thinned by stages to single plants, the last thinning being left as late as possible. To avoid root disturbance to the survivor at this last thinning, when plants are getting big, we have usually cut off the discarded plant at ground level rather than pull it up, in the belief that when cut below the cotyledonary node the cotton plant could not regenerate its aerial parts and must die. While such has commonly been the case, a number of instances of adventitious shoot formation, as above described, have been observed.

Similar cases have occurred in the field after cutting out with a heavy digging hoe below soil level, and discontinuing irrigation. The photographs illustrate some of these latter cases, which have been observed in Sakel, Sea Island, and cottons of the Old World group (mainly *Gossypium arboreum* types).

The writer is not aware of any references to this property of the cotton plant, but, even if not new, the facts seem worthy of record as calling for caution on the part of experimental workers making similar assumptions to ours in so cutting our box-plants, and of growers in relation to their efficient cutting-out and blank period.

Received May, 1929.

BLACKARM DISEASE OF COTTON

BY

R. E. MASSEY

NOTE RECEIVED FROM THE AUTHOR AND MR. M C. HATTERSLEY SINCE THE ABOVE ARTICLE WAS PUBLISHED (SEE VOL. VI., p. 124).

REFERENCE has been made in the earlier paper to the presence of organisms other than *Ps. malvacearum* E F.S. in the tissues of cotton plants. Now every natural infection examined during the past three months has proved to consist of two bacteria: one the true *Ps. malvacearum*, and the other a bacterium which, while exhibiting morphological similarities in its early stages of growth on nutrient agar, is dissimilar in the character of the colonies on solid media and in liquid media containing sugars. Moreover, cultures given to us by other workers as *Ps. malvacearum* E.F.S. have proved to be a mixture of the two organisms.

Full details will be given in a later paper; the purpose of the present note is to correct the information given on p. 125, and to record a by no means obvious aspect of the disease.

Isolation of the two organisms is difficult, and neutral nutrient agar containing 1 per cent. glucose, and either 1/50,000 malachite green or 1/30,000 gentian violet, will be found useful in differentiating the bacteria, as the yellow bacterium absorbs the stain more strongly.

The colour of the true *Ps. malvacearum* E.F.S. on any solid media is a pale yellow, whilst its companion is a rich yellow. In an old normal mixed culture the pale colonies frequently overrun the yellow ones, when the association is apparent to the naked eye.

The reactions of the two organisms to the sugars tabulated on p. 125 are as follows; but it should be noted that in this instance the liquid medium containing the sugars (in each case 0·5 per cent.) consisted of—

Peptone	1 per cent.
Salt	Trace.
Sugar..	0·5 per cent.*
Distilled water.	

Medium adjusted to pH 6·8 to 7 with brom-thymol blue.

TABLE 1. (A).—SUGARS REACTIONS.

Sugars, etc.	*Ps. malvacearum,* *Strain* 12 *after* 2 *Days.*	*Ps. malvacearum,* *Strain* 12 *after* 3 *Days.*†	*Yellow Organism after* 3 *Days.*
1. Starch	1	2	0
2. Pectin	Slight	Slight	0
3. Mucic acid	0	0	1
4. Dextrin	2	2	1 bottom growth
5. Gum arabic	2	2	2 ,, ,,
6. Glucose	3	4	3 ,, ,,
7. Saccharose	2	3	2 ,, ,,
8. Xylose	1	1	2 ,, ,,
9. Maltose	1	2	2 ,, ,,
10. Ammonium oxalate ..	Trace	Slight	1 slime thread from bottom

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* By a typographical error 5 per cent. instead of 0·5 per cent. was given on p. 125, line 8, of the original paper.

† Pellicle in 1, 4, 5, 6 (slight), 8 (slight), 9. (Numerals 1 to 4 indicate degree of growth, 4 being strongest growth.)

Pure cultures of the yellow organism have proved to be non-pathogenic to seedlings infected in the succulent tissue of the upper stem by means of needle pricks, while pure cultures of *Ps. malvacearum* are more virulent than mixtures such as are isolated ordinarily from infected plants, as judged by the appearance of the infected regions. A higher percentage of deaths is also obtained with pure cultures of *Ps. malvacearum* than with natural mixtures when young cotton seedlings are infected.

Pending the appearance of a further article on *Ps. malvacearum*, it is of interest to note the rapid changes which take place when this organism is grown on solid agar media. Within twenty-four hours shrinkage of the protoplasm takes place, and after seventy-two hours the bacterial rods have given place to coccal forms which stain poorly, and appear to be surrounded by a capsule.

These coccal forms resemble those normally found in the host plant wherever the organism is resting; a notable example is the dry infected seed, where cells full of very short rods or coccal forms may frequently be found near the chalazal end.

It is believed that these abbreviated forms represent the resting stage of the organism, and that they are relatively highly resistant to heat, light, and dryness.

R. E. MASSEY.
M. C. HATTERSLEY.

April 14, 1929.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

The feature of the Indian statistics during the past season has been the occurrence of frost in the Gujerat district which so upset all calculations that the Government were unable to include any estimate at all for the districts affected in the " Final " forecast. The effect is seen in the total figures shown by the " Supplementary " Report, which on an acreage of 1,723,000 more than last year show an estimated crop of 325,000 bales less, whilst the average yield is only 85 lbs. per acre against 96 lbs. last year. Even this, however, does not make it the worst year in recent records, as 1926 was only 81 lbs. per acre. About 600,000 acres of the increased acreage were added in the Supplementary Report, mostly in Bombay and Central India. The table of the area, crop and yield by provinces shows the result in detail.

The failure of the Gujerat crop also makes a considerable difference in the distribution of the total crop by varieties. Gujerat includes two widely different districts; the northern part (Kathiawar) is mostly in the Dholleras area, while Broach of course includes some of the finest native long staple cottons in India. Normally the total crop of Gujerat is about a million bales, of which about 750,000 would be Dholleras and about 250,000 Broach. The effect of the frost is seen in Table III., which gives the crop by varieties. The Dhollera crop is down about 500,000 bales on last year's figures, and Broach about 100,000.

It may also be noted as of interest that the commercial crop in 1927-28 turned out to be, for the first time since 1919, actually smaller than the Government's estimate of the crop grown. As this very rarely occurs, we give a table showing the composition of the commercial crop since 1914-15. From this it will be seen that both Consumption and Exports were rather small last year. The result was no doubt a very large carry-over at the end of last season, but no complete statistics of the carry-over of Indian cotton even in India are available.

Our usual table of the smaller crops other than Empire (which are given in a separate table on page 254) is now fairly complete for 1927-28, but is as usual very far from complete for the current season. The chief item of interest is the figure given for the Argentine, which is from a private report and shows a very considerable increase on any previous year.

Our usual table of the Egyptian crop by varieties was omitted by accident in last issue, and we therefore give it now. The chief features are the continued reduction in the proportion of Sakel and the steady increase of Ashmouni, which is almost up to its record figures in 1924. "Nahda" is mentioned separately for the first time, and for practical comparisons should be included with Sakel. It will also be noted that the Pilion figures have shown an increase in the last few years, though not yet up to the record of 1926.

TABLE I.—INDIAN CROP, AREA, YIELD, AND PRICE, 1914–1928.

Seasons.	*Area (Acres).* 000's.	*Crop (Bales of* 400 *Lbs.).* 000's.	*Yield per Acre. (Lbs.)*	*Net Exports and Consumption.* 000's.	*Season's Average Prices.*	
					No. 1 *Fine Oomra.*	*Per Cent. on American.*
1914–15 ..	24,595	5,209	85	4,889	4·46	85
1915–16 ..	17,746	3,738	84	5,109	6·09	81
1916–17 ..	21,745	4,489	83	4,985	10·32	84
1917–18 ..	25,188	4,000	64	4,499	18·78	87
1918–19 ..	20,997	3,972	76	3,991	18·13	92
1919–20 ..	23,352	5,796	99	5,343	19·23	76
1920–21 ..	21,340	3,600	67	4,941	9·20	77
1921–22 ..	18,451	4,485	97	5,972	9·60	85
1922–23 ..	21,804	5,073	93	6,270	11·14	75
1923–24 ..	23,631	5,161	87	5,946	13·35	74
1924–25 ..	26,801	6,088	91	6,923	11·95	87
1925–26 ..	28,403	6,215	88	6,508	8·97	83
1926–27 ..	24,822	5,024	81	5,624	7·18	88
1927–28 ..	24,761	5,963	96	5,655	9·21	83
1928–29 ..	26,484	5,638	85	—	—	—

TABLE II.—INDIAN "COMMERCIAL" CROP.
(RUNNING BALES 000's).

Seasons.	*Net Exports.*	*Mill Consumption.*	*Domestic. Consumption.*	*Total.*
1914-15	2,118	1,771	1,000	4,889
1915-16	2,486	1,873	750	5,109
1916-17	2,081	2,154	750	4,985
1917-18	1,705	2,044	750	4,499
1918-19	1,238	2,003	750	3,991
1919-20	2,680	1,913	750	5,343
1920-21	2,113	2,078	750	4,941
1921-22	3,063	2,159	750	5,972
1922-23	3,411	2,109	750	6,270
1923-24	3,350	1,846	750	5,946*
1924-25	3,998	2,175	750	6,923
1925-26	3,775	1,983	750	6,508
1926-27	2,830	2,044	750	5,624
1927-28	3,140	1,765	750	5,655

* Up till 1923-24 the imports were deducted, because some of the mills in the Native States included foreign cotton in their consumption.

TABLE III.—INDIAN COTTON CROP: AREA, CROP, AND YIELD PER ACRE *BY VARIETIES.*

Varieties.	1925–26.			1926–27.			1927–28.			1928–29.		
	Area (Acres).	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*
I. *Mainly under ⅞ Inch Staple:*												
Oomra (Khandeish, Central India, Berar, and Central Provinces)..	8.970	1.633	73	8,224	1,573	76	8,096	1,891	94	8,257	1,937	94
Dhollera	3,173	630	79	2,485	569	92	3,072	858	112	3,031	380	50
Bengal Sind (United Provinces, Rajputana, Sind, Punjab, etc.)..	3,873	1,080	112	3,363	822	98	2,782	782	112	3,545	957	108
Comilla, Burma, etc.	696	159	91	588	114	78	470	104	89	457	92	81
Coconada	304	54	71	205	30	59	214	39	73	241	46	76
Total under ⅞ inch staple ..	17,016	3,556	84	14,865	3,108	83	14,634	3,674	100	15,531	3,412	88
Per cent. of total crop	59·7	57·0	—	60·0	61·9	—	59·1	61·6	—	58 7	60 6	—
II. *Mainly ⅞ Inch Staple and Above*												
Punjab (American)	1,148	359	125	1,134	229	81	750	219	117	961	187	78
Sind (American)	7	2	114	25	5	80	15	3	80	29	6	83
Broach	1,413	331	94	1,211	222	73	1,274	244	77	1,226	145	47
Coompta Dharwar	1,729	317	73	1,513	201	53	1,726	327	76	1,782	394	88
Western and Northern	2,233	385	69	1,795	173	39	1,534	221	58	1,789	341	76
Tinnevelly	705	180	102	525	135	103	568	148	104	623	165	106
Salem	194	36	74	181	34	75	181	34	75	211	37	70
Cambodia	415	155	149	309	116	150	287	123	171	370	160	173
Barsi and Nagar Hyderabad Gaorani }	3,631	929	102	3,264	802	98	3,792	970	102	3,962	791	80
Total ⅞ inch staple and above ..	11,475	2,694	94	9,957	1,917	77	10,127	2,289	90	10,953	2,226	82
Per cent. of total crop	40·3	43·0	—	40·0	38·1	—	40·9	38·4	—	41·3	39·4	—
Grand total	28,491	6,250	88	24,822	5,025	81	24,761	5,963	96	26,484	5,638	85

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TABLE IV.—INDIAN COTTON CROP: AREA, CROP AND YIELD PER ACRE *BY PROVINCES.*

	1925–26.			1926–27.			1927–28.			1928–29.		
	Area (Acres).	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*
Madras	2,921	569	78	2,231	388	70	2,123	447	84	2,467	534	87
Mysore	83	25	120	97	25	103	81	25	123	76	23	121
Hyderabad	3,781	1,060	177	3,267	808	99	3,631	951	105	4,019	895	89
Bombay*	8,123	1,567	77	6,918	1,290	75	7,765	1,802	93	7,629	1,339	70
Baroda	866	189	87	761	124	65	806	124	62	793	70	35
Central Provinces and Berar	5,385	980	73	4,864	977	80	4,796	1,235	103	4,972	1,301	105
Central India	1,369	270	79	1,297	223	69	1,263	234	74	1,301	245	75
Gwalior	651	116	71	649	107	66	585	115	79	645	107	66
Bengal	78	26	133	77	25	130	78	20	103	79	18	91
Bihar and Orissa	82	15	73	79	14	71	77	14	73	78	14	72
United Provinces	1,004	277	110	809	258	128	643	199	124	715	255	143
Rajputana	411	93	91	404	78	77	422	97	92	465	123	106
Ajmer Merwara	54	17	126	43	15	140	42	14	133	44	21	191
Punjab	3,052	908	119	2,803	599	85	2,067	602	117	2,825	616	87
North-West Frontier	32	7	87	30	5	67	11	2	73	17	4	94
Assam	47	13	111	46	15	130	45	15	133	44	17	155
Burma	464	83	72	447	73	65	326	67	82	315	56	71
Total	28,403	6,215	88	24,822	5,024	81	24,761	5,963	96	26,484	5,638	85

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* Including Native States, also Sind and Delhi. 000's omitted throughout in area and crop figures.

TABLE V.—SUMMARY OF THE SMALLER COTTON CROPS (OTHER THAN EMPIRE), 1914–1928.

IN 000'S OF 500 LB. BALES APPROXIMATELY.

	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.
Brazil	406	296	341	413	486	552	424	483	519	544	630	593	445	462	—
Peru	123	115	128	130	136	183	164	183	185	196	194	196	238	224	200
Mexico	112	100	106	110	237	203	220	169	191	168	257	198	352	165	272
Argentine	5	5	5	10	12	13	26	19	28	61	72	138	62	110	180
Other South American	9	8	8	9	9	7	30	41	37	85	95	85	87	103	—
West Indies (foreign) ..	13	15	11	11	12	16	13	22	17	17	18	20	22	17	—
Japan and Korea ..	68	63	63	79	92	118	127	128	205	197	182	188	239	224	—
East Indies, etc. ..	71	69	77	73	68	90	67	36	26	22	22	24	22	23	—
Persia	131	127	91	72	66	84	73	68	75	91	93	99	120	180	—
Europe and Asia Minor	148	123	130	117	108	125	116	52	56	116	143	176	171	179	—
Africa (foreign)	3	3	7	5	6	12	13	18	26	46	72	80	82	91	—
Total	1,089	924	967	1,029	1,232	1,403	1,273	1,219	1,365	1,543	1,778	1,797	1,840	1,778	—

TABLE VI.—EGYPTIAN CROP: AREA BY VARIETIES.

	1914.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.
Sakel	394,403	952,481	1,146,443	1,270,481	995,479	1,358,162	1,255,000	872,624	1,128,946	981,783	795,740	799,523
Per cent... ..	22·4	72·5	72·9	69·5	77 0	75·4	73·2	48·8	58·8	55·0	52·5	46·0
Ashmouni	353,882	273,936	334,160	283,906	170,514	276,193	310,150	796,362	270,842	667,474	599,149	768,411
Per cent... ..	20·2	20·8	21·3	15·5	13·2	15·3	18·1	44·5	14·1	37·4	39·5	44·2
Zagora	—	—	—	97,612	92,536	126,541	102,390		388,578			
Per cent... ..	—	—	—	5·3	7 2	7·1	6 0		20·2			
Pilion	—	—	—	—	319	20	*	49,960	72,799	102,394	74,451	97,218
Per cent... ..	—	—	—	—	0·02	—	—	2·8	3·7	5·7	4·9	5·6
Afifi	467,350	36,240	35,145	44,068	6,771	8,202	6,050	22,271	8,384	4,234	4,261	
Per cent... ..	26·6	2·7	2·2	2·4	0·5	0·5	0 3	1·3	0·4	0·2	0·3	
Assili	134,104	20,736	21,003	30,051	5,839	7,863	7,820					
Per cent... ..	7·7	1·6	1·3	1·6	0·45	0·4	0·5					
Abassi	12,281	4,871	3,718	12,558	1,267	2,274	*					47,437
Per cent... ..	0·7	0·4	0·2	0·7	0·1	0·2	—					2·7
Jannovitch.. ..	127,531	223	97	2,087	300	225	*	46,626	54,833	29,817	42,598	
Per cent... ..	7·3	0·02	—	0·1	0 02	0·02	—	2·6	2·8	1·7	2·8	
Nubari	261,775	21,587	23,611	37,320	8,645	11,090	10,660					
Per cent... ..	14·9	1·6	1·5	2·0	0·7	0·6	0·6					
Others	3,944	5,498	9,485	49,787	10,208	10,273	23,080				Nahda ..	25,883
Per cent... ..	0·2	0·4	0·6	2·7	0·8	0·5	1·3				Per cent.	1·5
Totals	1,755,270	1,315,572	1,573,662	1,827,870	1,291,878	1,800,843	1,715,150	1,787,843	1,924,382	1,785,702	1,516,199	1,738,472

* Included in Others.

EMPIRE COTTON CROPS FOR TEN YEARS 1919–28, EXCLUDING INDIA.

(*In bales of 400 lbs.*)

The seasons are given as covering two years (*e.g.*, 1926–1927) because in the majority of the countries named planting takes place in one calendar year and picking in the next. In a few of these countries, however (*e.g.*, Tanganyika, Iraq, Cyprus, Malta), the crop is harvested in the same year as that in which it is planted. In such cases the figures should be read as relating to the crop grown in the *latter* of the two years at the head of the column.*

COUNTRY.	1918–19.	1919–20.	1920–21.	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.
(1) Anglo-Egyptian Sudan	15,997	23,160	30,519	24,074	28,306	47,652	44,912	121,131	148,118	126,115 (1)
(2) Gold Coast	52	—	61	49	15	93	1,132	1,218	285	264 (2)
(3) Nigeria	17,500	16,200	30,000	15,096	16,811	25,694	39,137	47,909	27,464	20,930 (3)
(4) Uganda	36,530	47,694	81,365	48,290	88,046	128,604	196,038	180,859	131,728	138,486 (4)
(5) Kenya	100	100	500	417	1,200	1,653	2,250	2,046	1,232	1,241 (5)
(6) Nyasaland . ..	2,591	2,026	4,615	5,422	4,036	6,873	7,718	4,976	2,792	4,470 (6)
(7) Northern Rhodesia ..	56	35	100	80	102	500	379	506	32	17 (7)
(8) Southern Rhodesia ..	—	—	—	—	—	1,650	4,907	6,803	639	90 (8)
(9) Tanganyika	—	—	7,327	7,175	11,434	18,793	21,724	24,280	15,966	32,965 (9)
(10) Union of South Africa and Swaziland .	1,911	2,737	2,923	2,740	6,523	8,730	16,936	20,381	10,242	11,013 (10)
(11) West Indies ..	6,086	6,170	4,831	4,073	5,160	5,031	4,051	5,148	5,909	4,485 (11)
(12) Queensland	31	38	792	3,140	9,344	11,850	14,318	7,179	5,880	10,266 (12)
(13) Cyprus	3,325	2,687	2,547	1,505	2,233	3,397	3,320	4,614	2,110	2,146 (13)
(14) Malta	343	266	582	193	118	573	782	507	342	541 (14)
(15) Iraq	—	60	60	300	1,100	2,400	2,540	3,500	1,800	5,200 (15)
(16) Fiji	—	—	—	—	—	83	153	120	797	124 (16)
(17) Ceylon	—	—	—	—	49	324	121	261	186	202 (17)
	84,522	101,173	166,222	112,554	174,477	263,900	360,418	431,438	355,522	358,555
		Percentage Increase 19·7.	*Percentage Increase* 64·2.	*Percentage Decrease* 32·2.	*Percentage Increase* 55·0.	*Percentage Increase* 51·2.	*Percentage Increase* 36·6.	*Percentage Increase* 19·7.	*Percentage Decrease* 17·6.	

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* The adoption of this practice for the purpose of giving consistency to the records has necessitated the transference of the figures for certain countries to a previous column. The totals in this table will consequently be found to differ slightly from those previously published.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

293. Agricultural Implements Suitable for India. (Abstr. from *Agr. Jnl. of India*, xxiv., 1, 1929, p. 73.) In connection with the important article by Mr. A. P. Cliff on the question of adapting modern implements to the use of the ryot (*cf.* Abstracts 2 and 522, vol. v.), Mr. R. Cecil Wood suggests that instead of making modifications to the plough, to compensate for the difference between the furrow width and the draught width, the oxen should be yoked more closely together.

294. India: Cotton Cultivation in Cawnpore. (Abstr. from *Rpt. on the Agr. Stats. of Cent. Circle, Cawnpore*, 1927-28, recently received.) The distribution of J.N. 1 and C.A. 9 cotton seed was continued, but the real demand in the Circle is for a heavy yielding, high ginning percentage cotton of the type of Aligarh White Flower, which can be sown on the rains without preliminary irrigation. The work with heat-treated cotton seed was continued in the Circle by the Government Entomologist, and several varieties produced by the Economic Botanist were tried on a field scale at the Kalianpur Farm.

295. Agra and Oudh: Cotton Cultivation. (Abstr. from *Rpt. on the Administration of the Dpt. of Agr.*, 1928, recently received.) Investigation into the possibility of controlling the attack of pink bollworm was continued as the major research work of the entomological section. It was financed, as usual, partly by the Local Government and partly by the Central Cotton Committee.

Large-scale field experiments with heat-treated seed were continued at Hardwar, Cawnpore, and in Bundelkhand. Notwithstanding adverse weather conditions, an examination of the cotton indicated that the area in which seed had been heat-treated produced on the average 50 per cent. more marketable "kapas" than untreated areas.

296. Institute of Plant Industry, Indore. (Abstr. from *Ann. Rpt. for the year ended June* 30, 1928.) Since 1925, when actual work on the land commenced, the Institute has been brought into working order, and a number of definite improvements in the production of raw cotton and of related crops have been worked out which have been brought to the notice of the cultivators of Central India and Rajputana. With the development of local interest there has been an increase in financial support.

The preliminary work being now completed, the scientific side will be developed as rapidly as possible on the lines of the programme approved by the Indian Central Cotton Committee. This programme includes a botanical survey of the unit species of cotton; the creation, establishment and maintenance of an island of improved cotton on the Malwa plateau; the improvement of the fibre of the hardy Roseum type of cotton; a study of the physiology of the cotton crop and of the influence of environmental factors on the lint characters.

297. Bombay: Cotton Breeding Work at Dharwar Farm. (Abstr. from *Ann. Rpt. of Dpt. of Agr. Bombay*, 1926-27, received 1929.) "Three *herbaceum* cottons were obtained from Tashkent (Russian Turkestan) and grown during the year. Two of these did not yield any cotton. Of the third (2519) one plant grown in pot produced cotton, and its staple was found to be longer than that of Dharwar No. 1, being 1¼ inch. Flowers on this plant were selfed, and the seed obtained is sufficient for further testing. If it is found to breed true, we shall have something new in staple. The plant is interesting from another point of view also—it produced about twenty bolls, and all of them without exception were four-celled."

298. COTTON INVESTIGATION WORK IN THE PUNJAB. (Abstr. from *Rpt. of the Dpt. of Agr. Punjab*, 1927, Pt. II., vol. xi.) The following experiments are described: Varietal, cultural, and manurial experiments at the Hansi Station; rotational, irrigation, varietal, and manurial experiments at Lyallpur Agricultural Farm; varietal experiments at Montgomery, and varietal and ridge-sowing experiments at the Sargodha Experimental Farm.

299. COTTON GOODS IN INDIA AND FAR EAST: MANUFACTURE. By A. C. Laycock. (*Text. Weekly*, 1929, **2**. Abstr. from *Summ. of Curr. Lit.*, ix., **5**, 1929, **M. 6**.) The author discusses the effects of foreign competition and the unstable condition of Indian markets on Lancashire trade with India. The Japanese mills can take Indian cotton to Japan, pay freightage on it, spin it into yarn, weave it into cloth, pack it up and pay the freight on it back again to Bombay, pay the duty on it, and then sell the cloth in Bombay at a lower price than that at which the Bombay mills can produce it. The Japanese pay their workers 25 per cent. more than the Indian mills. The Japanese operative is probably as efficient as the Lancashire operative, but receives only about one-third the pay. The Japanese mills have been running twenty, twenty-two, and twenty-four hours a day, in two shifts, so that the problem of Japanese competition is a serious one. In relation to trade with China, the competition of Japan and other countries has played a part, and the unsettled state of the country during the past three or four years has had a serious effect on Lancashire. The Eastern Textile Association Ltd., by mass production and a cutting down of all costs to a minimum, has succeeded in putting a certain cloth into the China market at a price lower than that of the Japanese product. The real and substantial cut in this case has been made by the dyers, and critics of the "E.T.A." claim that they could also produce the cloth at as low a figure if the dyers would take the same price for them. The "E.T.A." system involves a change in trading methods, but the author believes that the present system of merchanting is the right one.

300. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS. By A. J. Turner. Copies have been received from the Indian Central Cotton Committee of reports on the cottons named below. The particulars include Agricultural Details, Grader's Reports, Fibre Particulars, Spinning Tests, Remarks and Conclusions.

(1) *Surat* 1027 *A.L.F.* Samples from six seasons. This variety is derived from a hybrid (1027) originally made at Kirkee Farm in 1902 between Kumpta and Goghari cottons. The present 1027 A.L.F. is a pure line from an individual selection made in 1917-18. The area under cultivation in 1926-27 was 465,000 acres. The yield of seed cotton at Surat Farm is 586 lbs. per acre. The cotton is described as suitable for 26s to 32s warp.

(2) *Umri Bani.* 1928-29. Area under cultivation 225,000 acres under Government seed, 540,000 acres under cultivators' seed (mixed Gaorani). This cotton does not give quite as good strength as that of previous seasons; it is described as suitable for 22s warp.

(3) *Punjab-American* 4F. 1928-29. This variety in 1928-29 contained more foreign matter than in the three previous seasons, and was decidedly inferior. It was described as suitable for 16s warp, but two further samples tested at a later date were found to give rather better results, proving suitable for 18s warp.

(4) *Punjab-American* 289F. 1928-29. Area under cultivation 1927-28 about 3,000 acres. The cotton is described as suitable for 38s warp.

[*Cf.* Abstracts **190**, **524**, and **525**, vol. v., of this Review.]

301. Note on the American Cotton Crop Failure in the Punjab. By W. Roberts, British Cotton Growing Assc. (Punjab) Ltd., Khanewal. (Abstr. from *Agr. J. of India*, xxiv., 11, 1929, p. 77.) The history of American cotton in the Punjab during the past nine or ten years has been one of occasional serious crop failures, with consequent heavy monetary loss to growers. Various theories as to the cause of the calamity have been advanced, and the result of observations would seem to point to the "White Fly" of cotton (Aleyrodid) as the main cause of the disease from which the crop has suffered. The lines along which it is hoped to overcome the trouble are, briefly, as follows: (1) Later sowing—*i.e.*, June instead of May.

(2) The selection of resistant varieties. (This ultimately will be the main solution.)

(3) The application of nitrogenous artificial manures, especially late in the season, say September.

(4) Spraying, especially in May and June, to check the disease in its early stages.

(5) Destruction of the pest during the cold weather period. "White Fly" has a very large number of alternate host plants: these are being studied by an entomologist this winter.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

302. The following reports have recently been received:

- Imperial College of Science and Technology, Twenty-first Ann. Rpt. of the Governing Body, 1928.
- Imperial Institute, Ann. Rpt. for 1928.
- Gold Coast: Rpt. of the Dpt. of Agr., 1927-1928.
- India: Rpt. on the Admins. of the Dpt. of Agr. Agra and Oudh, 1928.
    - Rpt. on the Agr. Stations of the Western Circle, Agra and Oudh, 1928.
    - Rpt. of the Agr. Dpt., Bihar and Orissa, 1927-28.
    - Rpts. on the Agr. Stations, Central Circle, Cawnpore, 1927-27 and 1927-28.
    - Mysore Agricultural Calendar, 1929.
    - Rpt. of Dpt. of Agr. Punjab, 1927, Pt. II., vols. i. and ii.
- Kenya Colony: Ninth Ann. Rpt. of the Dpt. of Agr., 1928.
- Nigeria: Ann. Rpt. of the Northern Provinces, 1927.
- Sierra Leone: Ann. Rpt. of the Lands and Forests Dpt., 1927.
- Southern Rhodesia: Rpt. of the Dpt. of Agr., 1928.
- Tanganyika: Trade Rpt. for the year 1928.
- West Indies: Econ. and Finan. Conditions in the Br. West Indies, 1928.

303. AFRICA: Gold Coast. *Cotton Cultivation.* (Abstr. from *Rpt. of Dpt. of Agr.*, 1927-28, p. 7.) The establishment of a cotton industry in the Northern Territories is at present uncertain, and in view of the difficulties in the way likely for some time to be uneconomic. The problem of low yields has to be solved, and in addition a type of cotton must be evolved which is suitable for, and can be recommended to, the farmer. The work of the Agricultural Department during the year has been confined to the initiation of exact field experiments, a limiting of the sphere of operations, and the continuing of a restricted scheme of seed distribution and purchase. The area to be concentrated on is about 500 acres belonging to farmers within a twenty-five to thirty mile radius of Tamale, and a bonus scheme will operate for cotton grown with seed approved by the Department. At Tamale and Kpevi, types suitable to the districts are being selected by the Economic Botanist, and at the latter station experimental work is also being undertaken.

A considerable quantity of cotton was grown in the past season in Togoland, and was bought by the Department at a fixed price for unstained lint. The

work of divorcing the farmer here from the "kidney" type of cotton is progressing by means of the distribution of seed from Nigeria. Depredations due to cotton stainers have been more serious in the southern section, where Sea Island cotton is grown, than in the northern section.

304. NIGERIA. *Ginneries.* (Abstr. from the *Rpt. of the Dpt. of Agr.*, 1927-28.) The following ginneries are now in operation in the Northern Provinces: Zaria, Funtua, Duchi-N-Wei, Karadua and Malumfashi in Zaria Province; Challowa in Kano Province; Gusau in Sokoto Province, and Lokoja in Kabba Province.

305. *Improved Ishan Cotton.* (Abstr. from *Sessional Paper No.* 1 *of* 1929, p. 3.) In his address delivered at the Seventh Session of the Legislative Council of Nigeria, held at Lagos on January 31 last, Sir Frank Baddeley, President of the Council, stated that the climate of the 1927-28 cotton season was exceptionally dry and unfavourable, but in spite of these adverse conditions, sixty-three bales of Improved Ishan cotton were produced for export. Of 25 tons of seed available for distribution in 1928, 16 tons had been sold for planting and 4 tons distributed free to those farmers at Meko and Iseyin who were participating in the "seed-multiplication" scheme. The present season, so far, had been much more favourable, and it was hoped that over 1,000 bales of "Improved" cotton would be produced and exported this year.

306. SIERRA LEONE. *Cotton Trials.* (Abstr. from *Ann. Rpt. of Lands and Forests Dept.*, 1927.) Seasonal and variety trials were continued with the following cottons: Allen Long Staple, Cambodia, Delta Webber, four strains of Nigerian Cotton, Ishan, Acala, Nunns 37, and three strains of Punjab-American. As most of these cottons were planted at the end of the rains, the harvesting was not completed until 1928. The trials on the whole were disappointing; the plants did not seem happy and vigorous under Sierra Leone conditions.

307. SOUTHERN RHODESIA. *Cotton Cultivation.* (Abstr. from *Rpt. of the Sec. Dpt. of Agr.*, 1928.) From the report of the Secretary for Agriculture we quote the following: "Although the acreage planted to cotton was the lowest since 1923, the cotton industry now shows indications of making satisfactory progress. This position is entirely due to the untiring efforts of the Cotton Specialist and his staff. The experiments which for the past few years have been carried out at the Cotton Seed Breeding Station at Gatooma are already giving results which may be of the greatest value to the cotton industry in the Colony. In this connection the Cotton Specialist, who is particularly careful in his expressions of opinion, states: 'The behaviour of the jassid-resistant Cambodia strain which was grown for the first time on the station at Gatooma in 1926-27 fully justified the expectations which were then entertained. This variety matured so well when all other cottons failed to open properly that the chief obstacle to successful cotton-growing appeared to be solved. Further proofs were necessary, however, before coming to any definite conclusions. These proofs fortunately were forthcoming, and the behaviour of the strain known as U 4 in particular has gone far to demonstrate that cottom may yet be successfully grown in Southern Rhodesia.' This expression of the views of the Cotton Specialist is most encouraging, and shows that the untiring labours of the staff of the Empire Cotton Growing Corporation in this Colony are likely to be rewarded."

308. *Seed Supply to Farmers.* (Abstr. from *Rpt. of the Sec. of Agr. S. Rhod.*, 1928.) In his report for the year 1928, Mr. Cameron states that from 15 lbs. of U 4 seed received from Mr. Parnell, approximately one ton of seed was produced at the end of the season on the Cotton Breeding Station. This seed has been distributed for farm multiplication to seventy farmers throughout the country.

Arrangements have been made whereby the farmers retain 25 per cent. of the seed obtained from their crops, the remaining 75 per cent. to be sold to the Government at a fixed price for re-sale to cotton growers in 1929. What the return will be from the farm multiplication of this seed it is not possible to foretell. If farmers will hand-plant in order to economize seed for the ensuing first year of general cultivation of U 4, it should be possible to attain a total area of 10,000 acres, and provided there are no severe and unforeseen attacks of bollworm, and a fair average season is experienced, the average indicated above might be trebled. At the time of writing the report the seed had germinated fairly well, and the outlook promised to be satisfactory.

309. SUDAN. *Gezira Irrigation Project.* (Abstr. from *Text. Rec.*, xlvi., 552, 1929, p. 75.) The dam and canalization scheme from the Blue Nile brought under cultivation some 300,000 acres in the first season, including 80,000 acres actually sown with cotton and watered, as compared with a maximum area of 20,000 acres under cotton with the pumping schemes. The total cultivation area is now 3,000,000 acres, a wonderful achievement of British enterprise and capital.

310. AUSTRALIA: QUEENSLAND COTTON BOARD. (Abstr. from *Queens. Agr. Jnl.*, xxxi., 1, 1929, p. 87.) An Order in Council has been approved providing for six representatives of growers on the Cotton Board instead of five representatives as previously.

311. *Cotton Experimental Work, Callide Research Station,* 1927-28. (Abstr. from *Ann. Rpt. Callide Cot. Res. Sta.*, Biloela, 1927-28.) The climatic conditions were, on the whole, favourable, and most of the plots gave satisfactory yields. Rotation of crops, and green manure and other fertilizer experiments were continued. The time-of-planting experiments were all in favour of early planting. Other experiments were carried out in connection with hill planting, thinning, spacing, ridging, height of thinning, methods of cultivation, etc., as well as work in plant breeding and in the control of insect pests.

312. WEST INDIES: COTTON IN BARBADOS. (Abstr. from *Ann. Rpt. of Dpt. of Agr.*, 1927-28, recently received.) The great damage caused by pink bollworm in 1926-27, coupled with the almost entire absence of a market for Sea Island cotton, resulted in the planting of only a small area of cotton in 1927-28. For the first time all the seed for planting was issued through the Agricultural Department. Germination of the seed was poor, owing in many cases to bad planting.

On the advice of Mr. H. C. Sampson, C.I.E., Economic Botanist at Kew, it was decided to introduce strains of long staple American Upland, for which there is a consistent demand, and seed of eight different varieties was accordingly imported from America. The performances of these plants will be closely studied and compared with the existing Sea Island types, with a view to determining their suitability for the Island.

313. COTTON IN MONTSERRAT. (Abstr. from *Trop. Agriculture*, vi., 3, 1929, p. 85.) The quality of staple of the 1928 cotton crop received an exceptionally good report from brokers in Manchester. The percentage of stains in the whole island's crop worked out at only 4 per cent. On the whole, high yields per acre were recorded throughout the island. Damage by pink bollworm was negligible. Cotton sales have been much quicker and prices better than those of recent years.

314. COTTON IN NEVIS. (Abstr. from *Trop. Agriculture*, vi., 3, 1929, p. 85.) A good cotton crop is expected. On account of the hurricane, the local Government made a free gift of two tons of first-class cotton seed, which was distributed to the small growers, and was of very great assistance to them. There are about 1,400 acres in cotton, more than half of which is grown by the small growers.

815. Cotton Prospects in St. Vincent. From a report, recently received, on the cotton crop for the quarter ended March 31, 1929, we learn that the return per acre for the 1928-29 Sea Island crop will again be indifferent, heavy rainfall during the bolling period, accompanied by fungoid disease, being responsible for this. Phytophthora was the chief cause of losses. Stainers (*Dysdercus*) appeared in the cotton fields towards the end of the season, but did little damage.

COTTON IN THE UNITED STATES.

816. Retrospect of the 1928 U.S.A. Cotton Crop. By N. S. Pearse. (*Int. Cot. Bull.*, vii., 26, 1929, p. 290.)

817. Commercial Fertilizers in 1927-28 and their Uses. By G. S. Fraps and S. E. Asbury. (Abstr. from *Bull. No.* 387, Tex. Agr. Exp. Sta., 1928.) Contains statistics regarding fertilizers sold in Texas, information in reference to the fertilizer law, and analyses of samples of the fertilizers sold by different manufacturers. A discussion is also included of the use of fertilizers, and suggestions for their use on various crops and in various sections of the State.

818. Cotton Experiments in Arkansas. (Abstr. from the *Fortieth Ann. Rpt.*, 1928.) Breeding, spacing, and varietal experiments are described, also several experiments in connection with fertilizers.

819. Cotton Experiments in Georgia. (Abstr. from *Forty-first Ann. Rpt. Ga. Exp. Sta.*, 1928.) Cotton plants grown in a number of nutrient solutions containing nearly equivalent amounts of ammonia nitrogen and nitrate nitrogen, in all cases absorbed more nitrate nitrogen than ammonia nitrogen. Three cotton plants three weeks old grown in a quart of nutrient solution containing ammonium sulphate as the sole source of nitrogen, changed the pH concentration of the soil from 5·8 to 4·0 in forty-eight hours. Cotton plants grown in a nutrient solution containing nitrates as the source of nitrogen at an initial pH 5·6, developed severe chlorosis at the age of three weeks.

Preliminary work has been started on the effects of boron, manganese, copper, zinc, and iodine on the growth of cotton plants.

820. Cotton Investigations in Texas. (*Texas Sta. Rpt.*, 1927. Abstr. from *Exp. Sta. Rec.*, 59, 8, 1928, p. 732.) Studies with cotton at the station and substations embraced variety, cultural and fertilizer tests, breeding work, inheritance studies, and ginning experiments.

In a study of certain characters in Belton cotton, the percentages of vegetative branches and of 5-lock bolls varied considerably, and the percentage and length of lint relatively little. Fairly significant positive correlations were observed between plant height and (1) number of vegetative branches, and (2) percentage of 5-lock bolls, and between lint length and percentage of 5-lock bolls. It did not seem possible to select in the variety for lint longer than $1\frac{1}{16}$ in. without decreasing the lint percentage. The percentage of 5-lock bolls and of lint appeared to be inherited.

Noticeable decrease in the vigour of hybrid cotton plants was not evident after six years of inbreeding. A single factor appeared to be involved in the expression of lint percentage, lint colour, plant colour, and cluster type of boll formation, and two or more factors in the expression of fuzziness of seed, pubescence, and petal spotting. Linkage was observed between fuzziness and lint percentage. In hybridization studies normal green leaf was completely dominant to virescent yellow leaf, red leaf to virescent yellow leaf, and normal green leaf to leaf with plastid chlorophyll deficiency.

821. Varieties of Cotton for Central East Texas. By H. F. Morris and G. T. McNess. (Abstr. from *Bull.* 384, Texas Agr. Exp. Sta., 1928.) The results of tests carried out with ten varieties of cotton during the five-year period 1923-27 would appear to indicate that Acala cotton is the most suitable type for the region on account of its yield, length of lint, earliness, and ease of picking.

322. American Cotton Standards. (*Cotton*, M/c., 1928, 34. Abstr. from *J. of Text. Inst.*, xx., **3**, 1929, A. 156.) The United States Cotton Standards Act and the Universal Cotton Standards Agreement of 1923 and supplemental agreements are discussed. The advantages of the Universal Standards to growers, shippers, merchants, and consumers are emphasized. These comprise nine grades of "White" standards and various "Colour" standards. Representatives of various parties interested meet at Washington every two years for the purpose of examining and approving numerous sets of copies of the original Universal Standards agreed upon in 1923. Efforts have been made with a view to effecting agreements in regard to staple standards and representation of American cotton shippers at final arbitration in Europe. But in so far as Manchester is concerned, the question of staple standards is of little interest inasmuch as the bulk of the business is done "on type." The question of representation is to be considered.

323. American Cotton Futures Contract: Proposed Increase in Basic Staple. By C. H. Clark. (*Text. World*, 1929, **75**, 732-4. Abstr. from *Summ. of Curr. Lit.*, ix., **3**, 1929, M. 3.) The American consumption of 1 to $1\frac{1}{32}$ inch and longer cotton from the domestic crop has increased more rapidly than the average production of such cottons. Owing to inadequate marketing facilities and ignorance of values, most growers have found it more profitable to plant $\frac{7}{8}$ inch than the longer cottons. From the growers', manufacturers', and customers' standpoints the author makes out a strong case against the continued use of $\frac{7}{8}$ inch cotton as the basis for cotton futures contracts on domestic exchanges, and shows that a 1 to $1\frac{1}{32}$ inch basis would have many advantages and would encourage the growing of the longer cotton.

324. American Cotton Futures Contract: Proposed Increase in Basic Staple. By A. W. Palmer. (*Text. World*, 1929, **75**, 745-9. Abstr. from *Summ. of Curr. Lit.*, ix., **3**, 1929, M. 3.) The author discusses the facilities afforded by futures markets and examines in detail the possible effects of changing the staple basis. A study of the official data of domestic consumption, carry-over and ginnings by staple and grade, confined in the first two instances to the 1927-28 crop, and in the latter instance to the current crop up to December 1, indicates that $\frac{15}{16}$ inch cotton, rather than 1 inch, would offer the present broadest security of hedges and reliability of futures as price indices. The author admits, however, most of the advantages claimed for an increase in the staple length basis, and also that a sufficient increase in production of inch and longer cotton would justify a further stepping up of the staple basis.

325. Rationalization in the U.S.A. Cotton Industry. By A. S. Pearse. (Abstr. from *Text. Rec.*, xlvi., **552**, 1929, p. 35.) Pointing out that the American cotton industry is now as large as ours. Figures are given showing the inroads made by the United States into typically British markets. The rationalization of the industry that has been, and is still, going on, is then described.

326. Cotton Spinning in America. (Abstr. from *Text. Rec.*, xlvi., **553**, 1929, p. 30.) A note issued by th U.S. Dept. of Commerce contains some interesting figures about the relative activity in different localities of the cotton-spinning industry of the United States. Taking the month of February as an example, it is pointed out that although the cotton-growing States possess only 53 per cent. of the cotton-spinning spindles in place in the United States, these spindles did 68·16 per cent. of the work, as compared with 28·84 per cent. by the New England States, and 3 per cent. by all other States.

COTTON IN EGYPT.

827. Egypt. The number of *The Commercial* published by the *Manchester Guardian* for March 21, 1929, deals with Egypt. Among articles of special interest to cotton workers are the following: "The Land of the Small Farmer," by H. E. Nakhla el Motei Pasha; "Future of Long-Staple Cottons," by Dr. W. L. Balls and C. H. Brown; "World Consumption of Egyptian Cotton," by J. A. Todd; "Developing New Egyptian Cottons," by C. H. Brown; "Getting the Best from Seed and Soil"; "Preparing and Marketing the Cotton Crop"; "Cotton Ginning and Packing," by O. Abaza Bey.

828. Cotton Growing in Upper Egypt. Possibilities of the Future. By C. H. Brown. (Abstr. from *Man. Guar. Coml.*, February 14, 1929.) The advantages of Upper Egypt for cotton growing are: (1) It suffers less from bollworm attack; (2) Has a longer ripening season; (3) Overwatering of cotton by the fellaheen, resulting in excessive vegetative growth, is more difficult in the higher temperatures and lower humidity of Upper Egypt; (4) Nitrogenous manuring does not need such great care; (5) Excessive vegetative growth is checked by the greater heat.

The reason of the small area as yet cultivated is the difficulty of water supply. The rest of the paper is chiefly devoted to a discussion of the perennial and basin systems of irrigation.

829. Egyptian Cotton in America. Some Aspects of the Farmers' Relief Bill. By A. M. Psalti. (Abstr. from *Egyptian Gazette*, April 17, 1929.) A consideration of the probable effects in Egypt of the proposed legislation in the United States to levy a protective duty against Egyptian cotton. The author is of opinion that while at first such a tariff would react unfavourably on prices in Egypt, the latter's cotton is so much better and more plentiful than the American long staples, that supporters of the Bill in America would soon realize its uselessness if they considered the position thoroughly and from an impartial point of view.

830. New Egyptian Cottons. (*Man. Guar. Coml.*, 1929, **18**. Abstr. from *Summ. of Curr. Lit.*, ix., 7, 1929, E. 12.) The cotton growers of Lower Egypt, suffering from the liability of Sakel to pest damage, coupled with a steadily decreasing yield, are reducing their Sakel outturn and turning to higher-yielding varieties. A new cotton, Nahda, has been evolved from the old Nubari, which was one of the improved early growths of Lower Egypt. Nahda is deep brown in colour, fine, and with a staple of $1\frac{3}{8}$ to $1\frac{7}{16}$ inch. The yarn spun from it is extremely sensitive to dyeing processes, and has been notably in demand for the manufacture of velvets. The plant is strong, healthy, and pest-resistant, and shows at least one-third more bolls than a Sakel plant. The yield is rather disappointing, but the ginning yield is superior to that of Sakel. Gizeh No. 3 is of an Ashmouni stock produced by the Ministry of Agriculture. It has been particularly successful in the southern areas of Upper Egypt. It has a staple comparable to medium-stapled Pilion of $1\frac{5}{16}$ inch, is strong and fairly free from waste, and has passed all spinning tests. Gizeh No. 3 is a high-yielding variety, and is just entering on the stage of commercial cultivation. Gizeh No. 7 is long, strong, and silky in staple, and with a colour very close to that of Sakel. It is definitely "wilt"-resistant, and has given the best results in the southern areas of Upper Egypt and in the extreme north of the Delta. In its experimental stages it yields as heavily in the field as Ashmouni. Sakha No. 4 is still in the experimental stage. It is a bright, lustrous, long-stapled cotton, averaging about $1\frac{3}{8}$ inch, with a good break, and in general appearance closely resembles the best Sakel, but is rather rougher. It is a Delta cotton giving a

yield about 10 per cent. above Sakel, and has so far shown itself immune from "wilt."

[*Cf.* Abstracts, vol. iv., 352; vol. v., 396, 534, 535; vol. vi., 181, 183.]

331. THE MEASUREMENT OF THE DISCHARGE OF THE NILE THROUGH THE SLUICES OF THE ASWAN DAM. By H. E. Hurst and D. A. F. Watt. (*Phy. Dpt. Paper* No. 24, Egypt, 1928.) This paper summarizes the results of more than twenty years' work on the measurement of the discharge of the Nile.

332. SEASONAL VARIATION IN SALINITY OF NILE WATER IN THE ASWAN RESERVOIR AND AT RODAH (GIZA). By R. Aladjem. (*Bull. No.* 81, Min. of Agr. Egypt. Obtainable from the Publications Office, Government Press, Bulaq, Cairo, Egypt. Price: P.T. 5.)

333. THE TEMPERATURE OF CULTIVATED SOIL AT GIZA. By W. S. Gray and A. A. Nassar. (*Tech. and Sci. Serv. Bull. No.* 79., Min. of Agr. Egypt. Obtainable from Govt. Press, Bulaq, Cairo. Price: P.T. 5.)

COTTON IN FOREIGN COUNTRIES.

334. ALGERIA. COTTON CULTIVATION. By P. de Vilmorin. (*Biol. Abstr.*, 1928, **2.** Abstr. in *Summ. of Curr. Lit.*, ix., **5**, 1929, E. 10.)

335. REVUE DE LA SITUATION COTONNIÈRE EN ALGÉRIE. By C. Perret. (*Coton et Cult. Coton.*, vol. iii., **3**, 1928, p. 271.)

336. ARGENTINE REPUBLIC. COTTON CULTIVATION. (Abstr. from *Text. Rec.*, xlvi., **552**, 1929, p. 75.) The cotton crop of the 1927-28 season is estimated at 73,410 tons, prices to growers being remunerative. The number of persons engaged in cultivation is 23,399. The cost of production is one-third less than in the United States, land, labour, and transport being cheaper, while the yield and length of the fibre are superior. These conditions are offset by the extra cost of marketing under present conditions, lack of experience in organization, and the difficulties of the labour supply and transport.

337. BRAZIL. From the *Rpt. on the Finan., Coml., and Econ. Conditions in Brazil*, 1928 (S. G. Irving), recently received from the Dept. of Overseas Trade, we learn that the cotton piece goods industry is still in a depressed condition.

338. BRAZIL. COTTON CULTIVATION. By T. Buhler. (*Biol. Abstr.*, 1928, **2.** Abstr. in *Summ. of Curr. Lit.*, ix., **5**, 1929, E 10.)

339. LA CULTURE DU COTONNIER AU LOMAMI (CONGO BELGE). By A. Brenez. (*Bull. No.* 84, Assoc. Coton. Coloniale, 1928, p. 417.)

340. LE COTON DANS L'UELE (CONGO BELGE). By E. Dejong. (*Bull. Agr. du Congo Belge*, xviii., 1927, p. 451. Abstr. *Coton et Cult. Coton.*, iii., **5**, 1928, p. 154.)

341. LES RICHESSES DE L'AFRIQUE OCCIDENTALE FRANCAISE: V. LE COTON. (*L'Afrique Française*, Paris, 1928. Abstr. from *Int. Rev. of Agr.*, xx., **2**, 1929, p. 76.) Cotton has been grown in French West Africa only during the last few years. A Cotton Research Station has been established at Segu. Since 1927 the colony has exported 3,387 tons of cotton.

342. COTTON PRODUCTION IN FRENCH WEST AFRICA. By L. Blin Desbleds. (Supplement to *The Afr. World*, February 28, 1929.) An interesting account of the work of the Association Cotonnière Coloniale, which was formed in Paris in 1905.

343. COTTON IN HAYTI. By R. P. F. Edwards. (Abstr. from *Econ. Conditions in the Repl. of Hayti*, 1928, recently received from the Dept. of Overseas

Trade.) The total weight of the raw cotton exported was 4,427,337 kilos. Although the amount was not quite so high as in previous years, the price obtained was higher.

344. JAPAN COTTON INDUSTRY. (Abstr. from *Int. Cot. Bull.*, vii., **27**, 1929, p. 513.) The Department of Overseas Trade state that all cotton-spinning companies of standing, and who are members of the Japan Cotton Spinners' Association, intended to abolish night work as from February last. Those mills which voluntarily abolished night work before March 31 are subject to only 7 per cent. instead of 15 per cent. curtailment of activity at present in force.

345. STATISTICAL INFORMATION CONCERNING COTTON SPINNING IN JAPAN. Cotton Yarn Assen., Ltd. (Abstr. from *J. of Text. Inst.*, xx., **3**, 1929, T. 56.) A useful analysis of costs, wages, production, etc., similar to that given for India in a previous number.

[*Cf.* Abstr. **146** on p. 174 of this Review.]

346. JAPAN AND ITS COTTON TRADE. By W. B. Cunningham. (*Int. Cot. Bull.*, vii., **25**, 1928, p. 171.)

347. COTTON TRADE COSTS OF PRODUCTION IN JAPAN. (Abstr. from *Man. Guar. Coml.*, April 25, 1929, and May 2, 1929.) A comparison of the costs of cotton spinning and weaving in Japan and Lancashire.

348. LA CULTURE DU COTON AU MAROC EN 1928. By G. Carle. (*Bull. No.* 86, 1929, Assoc. Coton. Coloniale.)

349. MEXICO. COTTON PRODUCTION. (Abstr. from *Text. Rec.*, xlvi., **549**, 1928, p. 85.) The total production of cotton in Mexico for 1928 is estimated by the Mexican Department of Agriculture at 272,000 bales of 478 lb. net, compared with 179,000 bales for last year. This increase in the size of the crop is due to the fact that the total area planted is 60 per cent. larger than last year.

350. COTTON IN MOZAMBIQUE. By J. A. Evans. (*Colon. Mozambique Dir. Serv. Agr.*, 1928. Abstr. from *Exp. Sta. Rec.*, 60, **1**, 1929, p. 37.) Potential cotton districts, climate, planting periods, labour supply, and insect pests and diseases attacking cotton are described from a recent survey in Portuguese East Africa. While the colony as a whole is considered marginal and submarginal cotton territory, in certain areas in each district cotton might be grown in rotation with other crops with fair success if the best insect control methods were used.

351. PORTUGUESE EAST AFRICA. COTTON CULTIVATION. (Abstr. from *Trop. Agriculture*, vi., **2**, 1929, p. 52.) Several cotton plantations have started operations in the Lourenço Marques district, and native-grown cotton is an important industry in the territory of the Mozambique Company. Modern ginneries exist at Lourenço Marques and Beira, and also at Chemba on the Zambesi, where the Mozambique Industrial and Commercial Company have organized an experimental farm of over 12,000 acres.

An American expert investigated the prospects of this industry, but in his opinion the uncertain rainfall and the prevalence of disease make the future uncertain, unless irrigated land becomes available for the cultivation of cotton. A scheme has been prepared for irrigating the Limpopo Valley, which would appear a suitable situation for cotton growing.

352. COTTON GROWING IN RUSSIA. (Abstr. from *Text. Rec.*, xlvi., **553**, 1929, p. 79.) According to Reuter, the total area in the Soviet Union planted with cotton amounted to 90,000 hectares (222,000 acres) in 1928, compared with 740,000 hectares (1,827,800 acres) in 1914. This year it is proposed further to extend the cotton area.

353. Russia. Cotton Cultivation. We have received a copy of *Khlopkovoye Dielo*, No. 11-12, 1928. The list of contents, given in English, contains the following articles (in Russian): "New Method of Seed Cotton Storage," by A. D. Nissenhaus; "Methods of Definition of Some Qualities in Cotton Lint," by A. M. Schlossberg; "Tradition in Ginning," by D. A. Shepelevich.

354. Cotton Cultivation and Manufacture in Venezuela. By P. F. Martin. (*Text. Rec.*, xlvi., **552**, 1929, p. 75.)

CULTIVATION AND MACHINERY: IRRIGATION, ETC.

355. The Plant in Relation to Water. A Study of the Physiological Basis of Drought Resistance. By N. A. Maximov. (Authorized English translation. Edited with notes by R. H. Yapp. Published by George Allen and Unwin Ltd., London, 1929. Price 21s.) A very thorough and painstaking book, which presents in a readable form the results of the great amount of work that has been done for the advancement of this branch of plant physiology. It gives full references to the literature, and will be almost indispensable to all concerned with the physiology of plants in general, or of cotton in particular. Part I. deals with the Absorption of Water; Part II. with its loss, and Part III. with the Water Balance and Drought Resistance of Plants. In this part more especially, it will be realized that various long-cherished ideas in connection with transpiration in dry climates, absorption of water in salt soils, etc., stand in need of drastic revision.

356. Cotton Seeds: Their Absorption of Water, and Specific Gravity. By A. J. Turner. (Abstr. from *Agr. J. of India*, xxiv., **11**, 1929, p. 83.) The water displacement method of determining the specific gravity of cotton seed appeared to be unsatisfactory, and further experiments were carried out using liquid paraffin as the displaced liquid. The results obtained for the specific gravities of three groups of Punjab-American 4F cotton were as follows, compared with water at 78° F.:

	Specific Gravity.
For 110 small seeds, of average weight 0·0644 gramme ..	1·064
For 112 medium seeds, of average weight 0·0801 gramme	1·078
For 81 large seeds, of average weight 0·0966 gramme ..	1·069

357. Cotton. Cultivation and Manufacture. By W. Mayr. (*Textilberichte*, 1929, **10**. Abstr. from *Summ. of Curr. Lit.*, ix., **6**, 1929, M. 7.) A general illustrated account of the cotton plant and its cultivation, picking, ginning, transport, and marketing of the cotton, and the processes of manufacture, including some hand-spinning and hand-weaving processes.

358. Getting the Best from Seed and Soil. A Review of Production Methods. (Abstr. from *The Coml.*, M/c. March 21, 1929, p. 32.) *Section* I., "Soil Improvement," by A. Greiss Bey. II., "Seed Selection," by Dr. W. L. Balls. III., "Cottonseed Distribution," by A. Greiss Bey. IV., "Methods of Cultivation," by Hussein Enan. V., "Cotton Pests," by E. Ballard. VI., "Research," by Dr. W L. Balls.

359. Cotton Research in North Carolina. By C. B. Williams. (*N. Carolina Sta. Rpt.*, 1927.) The results of inheritance studies with cotton have thus far indicated that the fuzzy tip is a pattern character and is produced by a separate pair, or pairs, of characters from those which produce naked and fuzzy seed. It is very evident that this character is not an intermediate stage between the fuzzy and naked condition.

In variety tests, pedigreed strains of Mexican Big Boll cotton being improved at the station and substations produced a greater money value per acre than other cottons of the same or shorter staple, and in spinning tests these strains were found to be equal, and in some cases superior, to cottons of the same staple grown in the Delta and other areas reputed to produce cotton of an unusually high spinning quality.

In an experiment with heavy versus light seed for planting, seed weighing 0·12 to 0·13 germinated almost as well as seed weighing 0·15 to 0·16 gm., the plants appearing vigorous and growing off well. Seed weighing 0·08 to 0·1 gm. germinated 40 per cent. less than the heavy seed, 45 per cent. more of the seedlings died, and the plants were much smaller on June 30. Seed of a Mexican Big Boll strain grown at Oxford under late summer drought and on defoliated plants were much lighter, gave 25 per cent. less germination, and 20 per cent. more of the plants died than those from seed of the same strain grown under about normal conditions at Fayetteville.

Acid-delinted seed germinated quicker than machine-delinted seed, and both surpassed heat-treated seed and untreated seed, which were about equal. Acid delinting seemed to cause a greater liability to rot during a cold, wet spell, especially when planting is early. The best advantage is obtained from delinting seed when the planting is medium to late. Planting to a stand with acid-delinted seed with corn and peanut planters was found quite satisfactory, about 1 peck of seed being used per acre. Delinting with acid and the heat treatment reduced the amount of disease carried by the seed, the heat-treated plats showing slightly less disease on the seedlings than the acid-delinted plats.

Spacing experiments at the station and substations showed that cotton can adapt itself to a wide range of conditions. Closer spacings of from 8 to 10 inches in the row on poor soils and from 10 to 12 inches on more fertile soils, averaging two plants per hill, have slightly outyielded the wider spacings and also fruited earlier. For maximum yields, from 15,000 to 20,000 plants per acre, uniformly distributed, is the general recommendation.

360. Early Maturity in Cotton. By Dr. S. C. Harland. (Abstr. from *Trop. Agriculture,* vi., **4**, 1929, p. 114.) Early maturity is often desirable, whether upon account of a shorter growing season, or by reason of lessened liability to the attacks of pests or diseases. The factors bearing upon maturity are analyzed, each being considered in turn:

(1) "Period taken by seed to germinate," affected mainly by the temperature at time of sowing, but also affected by subsidiary factors like the presence of fuzz, etc.

(2) "Rate of growth of main axis," primarily genetic, but affected by environment.

(3) "The node of the first sympodium or fruiting branch, determining time of first flower," again largely genetic (Upland produces its first fruiting branch at nodes 6-9 above the cotyledons, Sea Island at 9-13.)

(4) "The time intervals between first nodes on successive sympodia, and from node to node along the sympodia " The time intervals increase as one goes up the plant, or gets to the end of the branch.

(5) "Genetic liability to shed buds before first flower," or (6) "buds and bolls during flowering period." Certain strains constantly shed the early buds.

(7) "Susceptibility to diseases which cause shedding," and (8) "prevalence of insects which do the same."

(9) "Time from flower to ripe boll." This varies from thirty days in some Asiatic cottons, to fifty-one in Sea Island (in the West Indies).

(10) "Form of flowering and fruiting curve as affected by density of spacing." Not only genetic, but also affected by the food supply. Experiment is needed to find the economic balance with density of spacing.

361. The Improvement and Selection of Cotton. (Trans. title.) By A. F. Kidder. (*Estac. Expt. Agr. Soc. Nac. Agr. Lima*, Circ. 8, 1928. Abstr. from *Exp. Sta. Rec.*, 60, 5, 1929, p. 434.) A discussion of the principles involved in the improvement of cotton.

362. The Effect of Spacing on the Yield of Cotton. By C. A. Mooers. (*J. Amer. Soc. Agron.*, 20, 1928, No. 3. Abstr. from *Expt Sta. Rec.*, 60, 2, 1929. p. 133.) Review of spacing tests with cotton in Texas and other Southern States gave evidence that with 3-feet rows 3 inches could be allowed either way from the next spacing without noticeable effect on yield. Somewhat closer spacing appeared necessary under conditions of higher productivity than low productivity. Texas data on two plants per hill were hardly conclusive, while Alabama and South Carolina results slightly favoured two or three plants per hill rather than one, but were unfavourable to four. Curves showed the best spacing to occur most often within 12 to 16 inch limits, with indications that slightly wider spacings may be warranted under Texas conditions. Exceptions may exist where closer or wider spacing than the general average may be justified.

363. Cotton Spacing. I. Studies of the Effect on Yield and Earliness. By J. O. Ware. (*Bull. No.* 230, Univ. of Arkansas Agr. Exp. Station, 1929.) From the conclusions we extract the following:

When conditions were favourable for the crop throughout the season the cotton plant was able to adjust itself to a wide range of stand without materially affecting production. Ordinarily, earliness was increased more by thicker stands than total yield, but unthinned plots usually reduced the first picking and total picking slightly. Much is lost in acre production by poor stands or even what the farmer has considered a normal stand. One year with another, the rate of stand that occurred in the check rows of two or three plants a hoe width apart to slightly thicker than this degree of thinning, was the best stand to leave in the row, the width of the row to be adjusted according to the fertility of the land, 3½ to 4 feet wide on rich land, 3 to 3½ feet wide on land of intermediate fertility, and 3 feet or less on poor land.

364. The Correlation between the Soil Salinity and Flowering Date in Cotton. By J. Arthur Harris. (Abstr. from *J. of Agr. Res.*, vol. xxxviii., No. 2, 1929, p. 109.) Consideration of the correlations between soil resistance and flowering date in an extensive culture of Pima Egyptian, Meade Upland, and Acala Upland cottons, made at the United States Field Station in the Gila River valley at Sacaton, Arizona, indicates that there is a low negative correlation between the soil resistance and the time required for flowering in these three varieties of cotton. Since soil salinity is measured in terms of resistance, while flowering date is measured in terms of days after an arbitrary origin date (June 1), negative correlation coefficients indicate that the flowering date is slightly retarded by soil salinity.

365. A Possible Relationship between Soil Salinity and Stand in Cotton. By J. Arthur Harris. (Abstr. from *J. of Agr. Res.*, 37, No. 4, 1928, p. 213.) The present investigation has dealt with the problem of the relationship between the concentration of the soil solution and the seedling stand produced in cultures of Pima Egyptian and of Meade, Acala, and Lone Star Upland cotton on heterogeneous experimental fields.

Soil salinity was measured in terms of the electrical resistance of the saturated soil mass in the standard soil bridge cup. Seedling stand was recorded in terms of number of seedlings produced per hill in hills planted with a uniform number of seeds (six per hill), in terms of numbers of seedlings per hill in hills producing at least one seedling, and in terms of number of seedlings per plot, each plot comprising an equal number of hills.

The data for an experiment conducted in 1922, which was admirably designed to throw light on this problem, indicate that there is a significant negative correlation between soil resistance and seedling stand. Since soil resistance is measured in ohms, and therefore increases with diminishing salt content, this negative correlation indicates that under the range of soil salinities and other conditions of the experiment better stands are produced on more saline soils.

These relationships should not be expected to hold if cotton were planted on soils of indefinitely higher salt content. They may be typical of soils having the degree of salinity here involved.

The results of an experiment made in 1923 do not fully confirm those of the 1922 experiment. It is the belief of the writer that the 1923 experiment was technically inadequate for an investigation of this kind. The results are included merely to avoid bias in the presentation of data.

Assuming that under certain ranges of field conditions there is a positive correlation between the concentration of the soil solution and the seedling stand of cotton (or, as here expressed, a negative correlation between the electrical resistance of the soil solution as measured in the soil and seedling stand), further problems as to the physical, chemical, physiological, and perhaps pathological causes of this relationship are presented for solution.

366. MAKING MECHANICAL ANALYSES OF SOILS IN FIFTEEN MINUTES. By G. J. Bouyoucos (*Soil Sci.*, 25, 1928, No. 6, pp. 473-80. Abstr. from *Exp. Sta. Rec.*, 59, **6**, 1928, p. 509.) This report, from the Michigan Experiment Station, continues the author's discussion of the hydrometer as a means for the mechanical analysis of soils, and the determination of soil colloids. It is considered to have been already shown that the hydrometer gives an average measurement of density for the entire liquid down to the top of the column of soil solids. The present paper presents determinations of the combined sand, the silt, and the clay, or colloids, in thirty soils, as compared with similar data on the same samples secured by the U.S.D.A. Bureau of Soils with the use of the usual mechanical analysis procedure. It also discusses, as in the preceding papers, the differences in the silt and clay fractions as determined by the two methods in cases where a considerable portion of the silt is of the finer sizes, reiterating the view that in such cases the silt fine enough to be classed as clay by the hydrometer method should properly be included with the clay, and briefly discusses the application of Stokes' law to the calculation of particle size from the hydrometer method data. The conclusions are essentially those noted in the previous papers supported by additional experimental evidence.

[*Cf.* Abstr. **295**, vol. iv. of this Review, p. 177.]

367. THE HYDROMETER METHOD FOR MAKING A VERY DETAILED MECHANICAL ANALYSIS OF SOILS. By G. J. Bouyoucos. (*Soil Sci.*, 26, 1928, No. 3. Abstr. from *Exp. Sta. Rec.*, 59, **9**, 1928, p. 809.) Extending the scope of his hydrometer method, previously reported from the Michigan Experiment Station, the author reports in the present paper the results of an examination of fourteen soils by the determination of the hydrometer readings of their suspensions at the end of 1, 2, and 15 minutes, and 1, 4, 8, and 24 hours, showing that by the application of Stokes' law such data can be made to yield a mechanical analysis considerably more detailed than that formerly made available by much more time-consuming procedures. "More than ten soils can be analyzed in one or two days, and a greater number of textural divisions can be obtained than in the regular mechanical analysis method."

The data presented include the particle diameter represented by each of the readings as well as the percentage of the corresponding fraction present in the sample in each case.

368. Some Comments on the Hydrometer Method for Studying Soils. By B. A. Keen. (*Soil Sci.*, 1928, No. 4. Abstr. from *Exp. Sta. Rec.*, 60, 1, 1929, p. 18.) This is a discussion of certain statements of Bouyoucos. Though admitting the rather close reproducibility of the hydrometer method results, and specifically stating with respect to the hydrometer soil analysis that his comment here presented " is not intended . . . to deny its value as an empirical method," which value he finds to be considerable, the author insists upon the essentially empirical character of the procedure, referring to its deviser's most recently published figures as illustrative of his contention that the " accurate repetition of a given result does not turn a qualitative method into a quantitative one, if we retain, as we ought, the strict meaning of these words."

[*Cf.* Abstracts **366** and **367** above.]

369. Soils and Fertilizers. By E. M. Crowther. (Reprinted from *Rpts. of the Progress of App. Chem.*, xiii., 1928.) A review of recent progress in the study of these subjects, with references to the literature, which will be very useful to all concerned.

370. Soil Zeolites and Plant Growth. By J. F. Breazeale. (*Tech. Bull. No.* 21, Univ. of Arizona, 1928.)

371. The Usefulness of Capillary Potential to Soil-Moisture and Plant Investigators. By L. A. Richards. (*J. of Agr. Res.*, vol. xxxvii., **12**, 1928, p. 719.) Studies on the movement of soil moisture and its availability to plants have been largely experimental, and there is need of a comprehensive, guiding theory. The energy potentials and dynamical methods which have been found so useful in studying electricity and heat may be equally well employed in soil-moisture investigations.

A discussion is given on the nature and use of potential functions, and the electrostatic, gravitational, pressure, capillary, and total potentials are defined. It is shown that, when the proper units are used, the value of the capillary potential in soil which is in moisture equilibrium with water through a porous clay wall is numerically equal to the difference in pressure in the water and atmospheric pressure. The capillary potential is therefore a measure of the pressure in the soil solution. The factors determining the capillary potential in a moist soil are discussed, and experimental data are given which show the relation between this function and the percentage of moisture for four different soils.

A new form of porous clay apparatus is described which can be used in controlling soil water for potted plants.

372. Fertilizer Ratio Experiments. By R. P. Bledsoe and J. J. Skinner. (*Bull. No.* 151, 1929, Ga. Exp. Sta.) Describes experiments conducted for the purpose of studying the effect of different fertilizer ratios on Cecil sandy clay loam with cotton, corn, and wheat grown in rotation.

373. Fertilizer Tests with Cotton. By J. T. Williamson. (Abstr. from *Thirty-eighth Ann. Rpt. of Agr. Exp. Sta. Alabama*, 1927.) The results of eight tests conducted to determine what fertilizer should be used on cotton following a legume that has been turned under, showed that the profitable fertilizer was 600 lb. acid phosphate and 75 lb. muriate of potash. The addition of 100 lb. nitrate of soda increased the yield of seed cotton only 5 lb. per acre. Where a satisfactory growth of vetch or other legume preceded cotton, there was no response to nitrate; if, however, the legume made rather poor growth, 100 lb. of nitrate of soda gave a profitable increase in yield.

374. Experiments with Fertilizers on Rotated and Non-Rotated Crops. By E. B. Reynolds. (*Bull. No.* 390, Texas Agr. Exp. Sta., 1928.) A report of experiments conducted over a period of fourteen years to study the effect of fertilizers, manure, removal of crop residues, and rotation on the yield of crops. The fertilizer treatments included superphosphate; superphosphate and manure; superphosphate and cottonseed meal; manure; rock phosphate; and rock phosphate and manure. Cotton and corn were grown continuously on the same land and in rotation with oats and cowpeas.

The soil responded more readily to nitrogenous than to phosphatic fertilizers, indicating a deficiency of nitrogen. The increases in yield, however, resulting from the fertilizer treatments were not in general very profitable. Manure was the most profitable treatment on cotton, giving an average yearly profit of $6·36 per acre. Superphosphate and rock phosphate were equally effective in increasing yields, but the latter being cheaper was the more profitable.

The removal of crop residues over a period of fourteen years has produced a slight, but not significant, decline in the productiveness of the soil.

Rotation produced significant increases in the yield of cotton and corn. The yield of cotton was increased 14 per cent. and corn 47·5 per cent. in comparison with the yield of continuous cotton and corn respectively. Rotation produced larger increases in yield than fertilizer, but the largest yields were obtained where rotation and fertilizer were used together; in fact, the increase in yield resulting from the combined use of rotation and fertilizer was greater than the sum of the increases produced by rotation and fertilizer when used separately.

Although rotation increased the yield of cotton and corn, the average acre value of the crops grown in rotation was less than the acre value of continuous cotton. The particular rotation of cotton, cowpeas, corn, and oats, therefore, was not profitable in comparison with continuous cotton, largely on account of the low acre value of cowpeas and oats. A two-year rotation of cotton and suitable feed crops should be satisfactory.

375. Experiment on the Rate of Absorption of Nitrate of Soda by Cotton. By W. W. Pate. (Abstr. from *Thirty-eighth Ann. Rpt. of Agr. Exp. Sta. Alabama*, 1927.) The time required for the absorption of 75 lb. of nitrate varied from eighty-three days when applied at planting to thirty-six days when applied thirty-nine days after planting, and to twenty-seven days when applied fifty-six days after planting.

376. North Carolina. Fertilizer Experiments. (Abstr. from *Exp. Sta. Rec.*, 59, 8, 1928, p. 732.) Varying the phosphoric acid percentage from 6 to 12 in a complete fertilizer did not materially alter cotton yields at the Upper Coastal Plain Substation, although the higher percentages of phosphoric acid markedly hastened maturity. As in previous years, varying the percentage of potash from 2 to 6 in a complete mixture did not affect yields materially. Contrary to previous results, maximum yields came from the lowest nitrogen application, and yields decreased as the nitrogen rose from 3 to 7 per cent. The largest yield from a 10-4-3 mixture was obtained from an application of 1,200 lb. an acre.

377. Fertilizers and Soil Improvers. By W. Gardner. (Crosby Lockwood and Son, London. 7s. 6d.) Reviewed in *West India Comm. Circ.*, xliv., 798, 1929, p. 176.

378. Agronomic Work in California. (*California Sta. Rpt.*, 1927. Abstr. from *Exp. Sta. Rec.*, 59, 8, 1928, p. 726.) The percentage of total cotton picked at first picking on a plat cut 14 inches deep between the rows was 46·5, and uncut rows 42, second picking 27·4 and 37·6, third picking 15·5 and 11·3, and fourth picking 10·8 and 9·1 per cent. Root cutting thus seemed to hasten maturity, permitting more of a crop to be picked earlier in the season. No data are given on the effect of root cutting on total yields.

379. Picked, Snapped, and Sledded Cotton. Comparison. By J. T. Wigington. (*Cotton*, U.S., 1929, 93. Abstr. from *Summ. of Curr. Lit.*, ix., 7, 1929, E. 13.) The results of mill tests of grade, staple length, visible waste, yarn strength and end breakages of picked, snapped, and sledded cotton of the same variety and from the same field are tabulated and discussed. The picked cotton gave the best grade and staple length, showed the smallest percentage of visible waste, and spun into the strongest yarn. The average end breakage per hundred spindles per hour was higher than for the snapped cotton, and much lower than for the sledded cotton. The snapped cotton was classed the same in grade as the picked cotton, but was slightly lower in staple length. The percentage of visible waste was greater and the yarn strength less than for the picked cotton. The average end breakage was lowest for the snapped cotton. The sledded cotton was classed one grade lower, was shorter in staple length, and contained more visible waste; and the end breakage was higher during spinning than for either the picked or the snapped cotton.

380. Variability in Staple Length of Some Commercial Varieties of Cotton. By H. E. Rea. (*J. Amer. Soc. Agron.*, 20, 1928, No. 7. Abstr. from *Exp. Sta. Rec.*, 60, 1, 1929, p. 37.) Studies at the Temple Texas Substation on the lint of sixteen varieties of cotton commonly grown in the State showed that most commercial cottons possess a high degree of variability in staple length. Certain varieties were consistently uniform as to staple length, even under widely contrasting climatic conditions, while other sorts consistently exhibited a high degree of variation. Some varieties showing considerable variation in length of staple in 1925 were relatively uniform in 1926, and the reverse was also true. Widely different seasonal conditions in the two years seemed to have no consistent effect on the variability in length of staple of the different varieties.

381. Research in Mechanical Farm Equipment. By H. B. Walker. (*Misc. Pubn. No.* 38, U.S. Dept. of Agr. Washington, D.C., 1928.) A report of a survey made during 1927 for the purpose of determining what are the pressing research problems in connection with mechanical farm equipment, and of formulating methods of attacking them through the established research agencies of the States and the Federal Government. The report is supplementary to one prepared by J. B. Davidson on the same subject, and issued in December, 1926.

382. Mechanical Harvesting of Cotton in North-west Texas. By D. L. Jones *et al.* (*Circ. No.* 52, Texas Agr. Exp. Sta., 1928.) Deals very thoroughly with the question. The harvesting problem is now the limiting factor in cotton cultivation in this region, but it is anticipated that satisfactory harvesting machines will eventually be developed.

383. Improvements to Cotton Gin. Soc. Alsacienne de constructions mécaniques. (Abstr. from *J. of Text. Inst.*, xx., 4, 1929, A. 169.) The surface of the leather roller, with rough grooves, is made with a single leather band rolled into spiral upon the periphery of the roller, and fixed to both ends.

384. The Middleton Cotton Gin. (Abstr. from *Int. Cot. Bull.*, vii., 27, 1929, p. 524.) The new Middleton roller gin, recently introduced by Messrs. Armstrong, Whitworth and Co., Ltd., has already been exported to India, Peru, East Africa, and Egypt, and reports from the users state that this new gin is giving every satisfaction.

The gin is equipped with roller bearings and oil baths for all moving parts. All belting has been eliminated, with a consequent gain in power and avoidance of slip. The makers claim that 25 per cent. less power is required for the Middleton gin, as compared with the older types. No oilers or belt attendants are required, and one fitter can overlook a larger number of gins. Adjustments of the gin for different lengths of staple are easily and quickly effected. It is furthermore fireproof, as no wood is used in its construction. The floor space occupied is only 5 feet 7½ inches by 3 feet 5½ inches.

385. COTTON GIN. EFFECT ON STAPLE. By H. S. Busby. (*Cotton*, U.S., 1929, 93. Abstr. from *Summ. of Curr. Lit.*, ix., 5, 1929, E. 11.) Improper ginning produces a high proportion of cut fibres, and may be unnecessarily wasteful. Incompletely carded and aligned fibres and the inclusion of short staple lengths which hamper the operation of the preparatory processes result from incomplete ginning. Staple distribution diagrams are given of samples treated by three different methods, as follows: (1) Staple pulled by hand from the seed. (2) Staple from ordinary types of gins in operation in the various growing sections. (3) Staple from a cleaning and opening treatment prior to ginning. The Murray-Hancock system of preparation and ginning was used. Comparisons show that the millable cotton yielded as a result of treatment prior to ginning is in excess, in quantity, over that ginned in the ordinary way, and that it has a high percentage of uniform staple and a low percentage of short staple or "tailings." Analyses of a typical case are given. In every case the net production of yarn is directly proportional to the main bulk of staple accumulation shown by the diagrams.

386. THE INTRINSIC STRENGTH OF COTTON. By N. W. Barritt. (Abstr. from *J. of Text. Inst.*, xx., 4, 1929.) The author states that the satisfactory establishment of a correlation between intrinsic strength and yarn strength would appear to present almost insuperable difficulties; but there can be little doubt that it exists. The increase of hair strength with humidity, or on mercerization, is reflected in the increase in yarn strength from the same cause, and probably is the best evidence obtainable in support of this correlation. The demand of the spinner for a strong cotton is doubtless a sound one, being based on long experience, but it is not apparently connected with strength per unit weight of fibre.

The results of tests carried out by Burd on Sea Island cotton gave an intrinsic strength of 278 for the commercial sample, which produced a yarn with a count strength product of 4,000, whilst Sakel cottons with an average intrinsic strength of 277 produced yarns with an average strength of only 2,000, though spun at more favourable counts. No evidence other than staple and fineness has yet been given to account for this difference in efficiency between these two types of cotton.

The grower must conclude that "fineness" is more important than anything else, but since there are two kinds of fineness it must be defined as low hair weight combined with maturity of the fibre. Maturity may be measured in terms of hair weight per unit diameter, so that the selection of cotton for staple and low diameter of fibre would appear to offer everything the spinner can reasonably ask and all the grower can hope to supply.

387. THE INFLUENCE OF THE THERMAL FACTORS ON THE DURATION OF PHASES DURING THE DEVELOPMENT OF THE PLANT. EXPERIMENTS WITH GRAMINEOUS (GRASSY) AND COTTON PLANTS. By T. D. Lisenko. (In Russian.) (*Works of the Azerbaidjan Central Exp. Station.* Pt. III., Baku, 1928.) *Conclusions.*—(1) In investigating the influence exerted by thermal factors on plant development, it is necessary to make a distinction between the growth of the plants considered as a whole and the various stages through which the plants pass.

(2) The intensity of the thermal energy is one of the chief factors which influence both the duration of the various stages in plant development, and of the entire vegetative period.

(3) In any individual plant each stage begins under strictly determined thermal conditions—*i.e.*, a temperature unsuitable for one stage may be necessary

for another stage. In the plants studied, no stage, with the exception of the one preceding the formation of floral organs, can begin until a temperature is reached which is specific to that stage (constant B).

In order to complete all its processes each stage needs a constant total of degrees-days (constant A) equal to the sum of the differences between the mean daily temperatures and the value of constant B for the whole duration of the given stage: $A = \Sigma (t^\circ - B)$. The number of days required for the completion of the stage is given by $n = \frac{A}{t^\circ - B}$.

(4) The values of the thermal constants, namely, of the initial constant B and of the required total of degrees in constant A, are not the same for the corresponding stages in different species. Therefore under one set of temperature conditions a given stage (and also the whole vegetative period) may be passed through more rapidly by one species than by another, while under a different set of temperature conditions it may last longer in the first than in the second.

The number of days (n) required for the completion of a stage depends on three values, namely, $n = \frac{A}{t^\circ - B}$ (where A and B are constant for each stage in a given species, and only t is variable); hence, in any two given species, if the value of the constant B is higher and that of A is lower for one species than for the other, the relative position of these two species in regard to the duration of their vegetative period will be interchangeable in accordance with the prevailing temperature.

Of two species (other conditions being equal), that species only will be an early maturing one under every set of temperature conditions for which the constant B is lower and the constant A is higher than for the second species.

(5) Different species of cereals at the stage of the formation of culms (*i.e.*, as defined in the text, when the first internode can be felt through the sheaths) stand in a different quantitative relationship to temperature. For this reason, a given species may be a spring form under one set of temperature conditions, and a winter form under a different set.

(6) A plant cannot enter a subsequent stage of development if it has not completed the stage immediately preceding it. Therefore, if the temperature conditions satisfy the requirements of all development stages except one, the plant will only reach the latter stage, and its further development will be arrested until the setting in of the temperature conditions corresponding to this stage. At suitably low temperatures (18° to 20° C.) cotton plants can pass through all stages of development preceding the stage of bud formation. If the temperature does not rise above the critical value of the constant B for this stage, the plant will be able to go through all the preceding stages, but it will not produce buds. However early the plant is sown, the formation of buds will not begin before a fixed calendar date characteristic of the given region.

(7) In choosing the date for sowing cotton in a given region, one should be guided not only by the existing spring temperature data, but chiefly by the mean daily temperatures during the following months over a period of many consecutive years, in order to be able to determine the average date on which the temperature conditions are such as to allow the setting in of the bud-formation stage of a given species. Working back from this date at which bud formation is theoretically possible, the dates of all the preceding stages—namely, fourth, third, second, first leaves, germination—and of sowing, can be worked out from the constants and the mean temperature conditions of the given region.

From these conditions it will be seen that in regions where there is a long spring season, during which temperatures are below the constant B for the bud-formation stage of the given species, the best crops will be yielded not by the plants that were sown the earliest (they would not, in any case, produce buds before a determined date) but by those that are sown later. In those regions, on the other hand, in which the temperature curve rapidly rises above the value of constant B for the bud-formation stage, it will be necessary not only to sow at the very earliest dates, but even (if economically admissible) to sow the cotton in seed beds and to replant the seedlings in the fields.

(8) In order to be able to make a preliminary selection of pure strains of cotton in respect of the earliness of their maturation, and also tentatively to assign various species for cultivation in different regions, it is necessary first to determine the thermal constants, if not for all the stages, then at least for the bud-formation stage, and to use these constants as factors influencing a decision.

388. LA PRODUCTION DU COTON "SEA ISLAND" By W. L (Abstr. from *Coton et Cult Coton*, vol iii, **3**, 1928, p 263) An interesting account of the cultivation of Sea Island cotton in the various countries in which it is grown.

DISEASES, PESTS, AND INJURIES, AND THEIR TREATMENT.

389. THE SCIENTIFIC PRINCIPLES OF PLANT PROTECTION By H Martin. (Edward Arnold and Co, London, 1928 Price 21s) A general survey of the whole subject, which will prove very useful to students, since it not only deals with all the available means of disease and pest control, but suggests various lines of future research

390. INSECTICIDES PREPARATION By W H Groombridge and A J Dickinson, Ltd, London (E P 301,186 of November 10 1927 Abstr from *Summ of Curr Lit*, ix, **4**, 1929, E 9) Insecticides for use particularly on cotton bollworm and leafworm are prepared by treating ammonium silico fluoride in an aqueous medium, with one or more soluble soaps

391. ON THE STUDY OF THE RESISTANCE OF INSECTS TO COLD By N Sakharov (In Russian) (*Zh opuitn Aqron Yu Vostoka*, vi, **2**, 1928 Abstr from *Rev App Ent*, xvii, Ser A 2, 1929, p 126) The resistance of the migratory locust is one of those considered

392. CHEMICAL HYDRATED LIME FOR THE PREPARATION OF BORDEAUX MIXTURE By E B Holland and G M Gilligan (*Phytopathology*, 17, 1927, No 8 Abstr from *Exp Sta Rec*, 60, **1**, 1929, p 49) Tests are reported of nine samples of chemical hydrated lime, representing deposits from Indiana, Missouri, Pennsylvania, Virginia, and West Virginia, used for the preparation of Bordeaux mixture All the samples tested are said to have proved satisfactory for this purpose, and they can be recommended as desirable substitutes for quicklime

393. THE EXPERIMENTAL METHOD AS APPLIED TO ENTOMOLOGICAL INVESTIGATIONS By W B Herms (Abstr from *J of Econ Ent*, vol xxii, No 1, 1929, p 45) The experimental method is regarded as the most important tool of research that scientists employ,' hence it is important that this method of investigation should be employed to best advantage by workers in the field of entomology To illustrate the use of this method experiments are cited in insect nutrition, hydrogen ion concentration medical entomology, plant diseases, insecticides, and light reactions The use of high grade instruments for observing, recording and regulating temperature, moisture, air movements, evaporation, humidity, etc, is strongly urged and a brief account is given of what the author believes to be the necessary qualifications of a worker in the field of experimental entomology

394. INDIA COTTON PESTS AND DISEASES IN THE PUNJAB (Abstr from *Rpt of the Dpt of Agr Punjab*, 1927, Pt II, vol i) Attention was chiefly devoted to investigation work on the pink bollworm, but research was also continued in connection with the following pests: Spotted bollworms, cotton stem borer, cotton bud caterpillars (*Phycita infusella*), *Myllocerus maculosus*, *Tarache notabilis*, *T. nitidula*, *Sylepta derogata*, *Amposea devastans*, and *Tokka* (*Chrotogonus*).

Investigations on the incidence of cotton root rot disease were continued, but the solution of the problem is not yet in sight.

395. Cotton Pests in Madras. By Y. Ramachandra Rao. (*Admin. Rpt. of Govt. Entomologist, Coimbatore*, 1927-28. Abstr. from *Rev. App. Ent.*, xvii., Ser. A. **4**, 1929, p. 235.) Cotton pests under investigation in Madras during 1927-28 included *Pempheres* (*affinis*, Fst., Stem weevil), and the bollworms *Platyedra gossypiella*, Saund. and *Earias*.

396. Boll Weevil Report. (Abstr. from *Text. Rec.*, xlvi., **553**, 1928, p. 79.) According to the report issued recently by the Bureau of Entomology, the number of live boll weevils found per ton of moss averages 107·7 per cent., against 74·5 per cent. last year in Texas; 70·7 per cent. against 21·2 per cent. in South Carolina; 38·7 per cent. against 88·7 per cent. in Georgia; 10·8 per cent. against 45·2 per cent. in Alabama; and 40·6 per cent. against 65·9 per cent. in Louisiana.

397. Weather and the Cotton Boll Weevil. By J. B. Kincer. (*U.S. Mo. Weather Rev.*, **56**, 1928, No. 8. Abstr. from *Exp. Sta. Rec.*, 60, **4**, 1929, p. 357.) A correlation of data on the weather and boll weevil occurrence obtained in the Cotton Belt States since infestation by the pest.

398. Pink Bollworm. (Abstr. from *Int. Cot. Bull.*, vii., **27**, 1929, p. 459.) Aeroplanes equipped with insect traps were recently placed in service in Mexico by the U.S. Government to study the movement of the pink bollworm moths, which are suspected of emigrating to U.S.A.

The traps consist of a sticky fly-paper preparation which holds the moth when it flies against it. The aeroplanes are sent over territory above which the moths are believed to be flying, and by opening the trap specimens are obtained. It was soon found that an unexpectedly large number of insects are present in the upper air, although many of these are insects which possess little or no power of flight, and thus are obviously carried involuntarily by air currents. The fact that wingless insects are taken up by winds proves how difficult it will be to prevent the spread of winged pests.

Age, sex and direction of flight of the insects from infested cotton fields are noted, and the scientists believe these data will enable them to determine the season and direction in which the insects travel.

399. Pink Bollworm in Texas. (*Rpt.* 1927-28 *of the Fed. Hort. Board*, Washington, D.C. Abstr. from *Rev. App. Ent.*, xvii., Ser. A., 1929, p. 221.) The situation regarding *P. gossypiella* is reviewed. At the beginning of 1928, this moth was found in seven new counties in western Texas. The extent of the infestation was determined, and control measures were immediately carried out. It had been hoped to eradicate the pest by the enforcement of non-cotton zones over this area during 1928, but the appropriation of Congress for the compensation of losses to farmers in non-cotton zones was only available for areas where live bollworms were found. Unfortunately, owing evidently to the severity of the weather, only dead bollworms were found in this case, although undiscovered bollworms may quite possibly have survived in seed carried away from the field to storage bins, gins, or mills, or in the soil about the base of the plants where they are fairly well protected by a covering of 2-3 inches of soil. Unless eradication can be effected, *P. gossypiella* will spread eastwards through the continuous cotton belt of Texas, and the hope of eliminating it will then have disappeared. In the areas in central and eastern Texas and in Louisiana in which *P. gossypiella* seems to have been eradicated, intensive investigations in connection with the 1927 crop revealed no sign of infestation. Infestation was found in an isolated field in the Santa Cruz valley of Arizona, a point further west than has yet been reached by the pest.

400. L'Earias Insulana et son Parasite Microbracon Brevicornis, au Maroc. By J. de Lepiney and J. M. Mimeur. (*Agron. Col.* No. 131, 1928. Abstr. from *Rev. App. Ent.*, Ser. A., 2, 1929, p. 101.) The bionomics of *Earias insulana*, Boisd. (spiny bollworm) are discussed; they are very similar in the cool climate of Morocco and in tropical regions. In order to keep *Earias insulana* well under control in areas where perennial as well as annual cotton is grown, the rate of parasitism must be very high. A parasite found on this pest has been identified as *Microbracon brevicornis*, Wesm. (*Rhogas kitcheneri*, Dudg. and Gough) by Ferrière, who points out that it is not identical with *M. hebetor*, Say, which attacks *Ephestia kuhniella*, Hb. and other Pyralids, and which has been frequently recorded under that name.

The eggs of *M. brevicornis* hatch in one to three days, and the larvæ attach themselves to the host immediately on emergence, thirteen having been observed on one individual. The pupal stage lasts seven days or less, and the maximum length of the life of the female adult in captivity was thirteen days. The total life-cycle in summer lasts from fourteen to seventeen days. Eggs are laid parthenogenetically, twenty-four hours after emergence; no fertilized eggs were found during the course of these investigations, males only being observed when larvæ of Earias were not available. Punctures are made in the body of the host larva, which dies in six to ten days. Eggs laid in larvæ paralyzed for more than forty-eight hours are unable to develop, and die with the decomposing host. In the laboratory one female laid seventy eggs in thirteen days, while individual hosts carried up to forty-two eggs.

401. Cotton Flea Hopper. By J. M. Robinson and F. S. Arant. (Abstr. from *Thirty-eighth Ann. Rpt. of Agr. Exp. Sta. Alabama*, 1927, received 1929.) Applications of sulphur (6 to 10 lb. per acre) at five-day intervals reduced the infestation and materially increased the yield of cotton. Sulphur and calcium arsenate (equal parts, 10 to 12 lb. per acre) indicated that it might be valuable in combating weevils and hoppers combined.

402. Insectos que Atacan al Algodon y a la Cana de Azucar en el Peru. By C. H. T. Townsend. (*Bol. Estac. exp. agr. Soc. nac. agrar.*, No. 1, Lima, 1928. Abstr. from *Rev. App. Ent.*, xvii., Ser. A., 2, 1929, p. 100.) The first part of this bulletin deals briefly with fifty-one pests of cotton observed in Peru. The weevil, *Gasterocercodes gossypii*, Pierce, is one of the most serious pests of cotton in Peru. It oviposits in the bark at or below ground level, and the larvæ mine into the stems and roots, withering of the leaves being the first symptom of injury. The only means of control is to clear the fields of all old roots, etc., and also of Hibiscus and Stylosanthes, replant every year with an early variety of cotton, and irrigate with the least possible quantity of water.

403. Informe sobre la Production de Algodon en el Valle de Cañete. By W. E. Hinds. (Abstr. from *Rev. App. Ent.*, xvii., Ser. A., Pt. 1, 1929, p. 23.) A leaf-eating caterpillar, *Anomis* (*luridula*, Guen.), appears to be chief pest of cotton in the Cañete Valley, Peru. Control by dusting with calcium arsenate or lead arsenate is advised. A simple duster has been devised, and as the life-cycle of the moth requires about twenty-five days, the dust should be applied every four weeks. A dust of 1 lb. 40 per cent. nicotine sulphate and 16 lb. of calcium arsenate or slaked lime is effective against *Aphis gossypii*, Glov. An account of the bionomics of the cotton square weevil, *Anthonomus vestitus*, Boh., is given.

404. Une Nouvelle Sphenoptera Parasite du Cotonnier dans la Somalie Italienne. By A. Thery. (*Ann. Mus. Stor. nat.*, lii., 1928. Abstr. from *Rev. App. Ent.*, xvii., Ser. A., **4**, 1929, p. 245.) The Buprestid, *Sphenoptera scebelica*, sp. n. is described from Italian Somaliland, where it is said to be a serious pest of cotton.

405. Southern Rhodesia. Cotton Pests. (Abstr. from *Rpt. of the Sec. of Agr. S. Rhod.*, 1928.) The major pests of cotton in 1928 include Jassid (*Empoasca fascialis*, Jacobi), Stainers (*Dysdercus* spp.), Sudan Bollworm (*Diparopsis castanea*, Hmpsn.), Wireworms (*Trachynitus* sp.), Spiny Bollworm (*Earias* spp.), and American Bollworm (*Heliothis obsoleta*, Fab.).

Further progress has been made in the study of the bionomics of the Jassid and Cotton Stainer pests. Experiments with poisoned bait against the adults of *Trachynitus* sp., the larvæ of which caused serious injury to cotton at Gatooma, gave satisfactory results. Effective baits included a moist mixture of either Paris green or arsenite of soda and maize meal, covered over with foliage or other available material. Proportions used were (*a*) 1 lb. Paris green in 180 lb. meal, mixed dry and moistened to a friable mash, and (*b*) 1 lb. arsenite of soda dissolved in 20 gallons of water and used to moisten maize meal to a friable mash.

406. Un Nouveau Parasite Occasionnel du Cotonnier dans la Vallée du Niger. By R. H. Lucky. (*Agron. colon.*, xvii., **128**. Abstr. from *Rev. App. Ent.*, xvii., Ser. A., Pt. 1, 1929, p. 51.) A leaf-cutting bee, *Megachile* sp., was observed in the Niger valley in 1925 attacking the foliage of imported cotton (*Gossypium hirsutum*). It appeared to avoid native varieties growing in the same region, but occurred frequently on *Zizyphus* spp.

407. Some Important Discoveries about Migratory Locusts in Other Countries and their Application in the Philippines. By F. Q. Otanes. (*Philipp. Agr. Rev.*, xx., **4**, 1927. Abstr. in *Rev. App. Ent.*, xvii., Ser. A., **2**, 1929, p. 109.)

408. Experiments with the Infestation of *Locusta Migratoria*, L. with Bacterial Disease. By O. G. Shulguina and P. A. Kalinitshev. (Trans. title.) (Gosud. Inst. Opytn. Agron. Leningrad. *Rpts. Bur. Appl. Ent.*, **3**, 1927, No. 1. Abstr. from *Exp. Sta. Rec.*, 59, **9**, 1928, p. 856.) This is a report of inoculation experiments in which a culture of *Bacillus acridiorum* and a mixed culture of bacilli obtained from Locusta nymphs, including *B. fluorescens liquefaciens*, *B. punctatus*, and *B. acridiorum*, were used. The best results, namely, 90 per cent. mortality, were obtained from infestation of the larvæ by *B. acridiorum* under conditions of temperature varying from 12·5 to 23·5° C. (54·5 to 74·3° F.). The same culture in a constant high temperature (33 to 35°) gave but 10 per cent. mortality. The mixed culture also gave little mortality, *B. acridiorum* in this culture being dislodged by other species of bacilli, *B. fluorescens liquefaciens* and *B. punctatus*.

409. Le Criquet Pèlerin et les Données Biologiques Récentes sur les Acridiens Migrateurs. By P. Vayssière. (*C. R. Assoc. franç. Avan. Sci.*, fifty-first session, Paris, 1927. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., Pt. 12, 1928, p. 650.) A brief review of the literature on locust periodicity and phases, with particular reference to *Schistocerca gregaria*, Forsk.

410. Les Recherches Récentes sur les Acridiens Migrateurs. By L. Chopard (*Rev. Hist. nat. appl.* [1], ix., **5**, 1928. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., Pt. 10, 1928, p. 500.) This is a brief summary of recent works on the bionomics of locusts.

411. Locusta Migratoria in Central Asia. By S. A. Predtetschenskij. (In Russian.) (Abstr. from *Rpts. of the Bur. of App. Ent.*, vol. iii., No. 2. Leningrad, 1928, pp. 113-199.) The present paper, of which a lengthy summary is given in English, is written as the result of the author's personal observations in the basin of the river Moksha, and of a critical study of the literature and of museum collections in connection with the Asiatic locust (*Locusta migratoria*, L.).

412. The Variability of *Locusta Migratoria*, L. By G. F. Gauze. (In Russian.) (*Déf. des Plantes*, iv., 6, 1927. Also in German in *Z. angew. Ent.*, xiii., 2, 1927. Abstr. from *Rev. App. Ent.*, xvi., Ser. A., Pt. 10, 1928, p. 486.) Detailed biometrical studies were undertaken to test the theory of phases in *Locusta migratoria* advanced by Uvarov. From a consideration of the tables of measurements made by Uvarov, as well as the actual specimens that served Plotnikov for his criticism of this theory, the author's conclusions are in favour of the theory, while several inaccuracies in Plotnikov's observations, and particularly in those by Makalovskaya, are pointed out. The paper is particularly important from the point of view of methods of studying variation in this locust.

413. Studies in the Wilt Disease of Cotton in the Bombay Karnatak. By G. S. Kulkarni and B. B. Mundkur. (*Mems. of the Dept. of Agr. in India*, Bot. Ser., vol. xvii., 2, 1928.) The following are the conclusions drawn: This study of the effect on cotton plants of solutions in which *Fusarium vasinfectum*, Atkinson (so closely associated with the wilt disease of cotton), had grown, leads to the conclusion, confirmed by microscopic evidence, that the primary factor leading to the death of cotton plants is not clogging of the vascular ducts by the mycelium of the fungus.

The active factor causing wilt in cotton plants used in these experiments appears to be a chemical compound or compounds occurring in the liquid in which the fungus has grown, which is not destroyed by boiling and which is not removable by filtration through porcelain filters. It is not, moreover, destroyed by heating the filtrates in an autoclave at 110° to 115° C. The nature of the substance or substances has not been determined, but lactic and oxalic acids are definitely excluded, and nitrites do not appear to be the cause of the result noted. The solutions in which the *Fusarium* had grown were not only fatal to susceptible types of cotton plants, but they also caused wilt symptoms in resistant types, and even in types (like Gadag 1) which are highly resistant and even considered as immune.

414. Cotton Root Disease. (Abstr. from *Forty-First Ann. Rpt. Ga. Exp. Sta.*, 1928.) The cotton seed treatment tests started in connection with the study of the root disease produced by *Fusarium moniliforme* have been continued in an effort to determine the comparative efficiency of liquid and dust disinfectants, and the commercial value of surface disinfection of cotton seed.

The results show that surface disinfection can be accomplished with dusts, which are much cheaper and more easily applied than the delinting method.

415. Relation of Cotton Root Rot and Fusarium Wilt to the Acidity and Alkalinity of the Soil. By J. J. Taubenhaus *et al.* (*Bull. No.* 389, 1928, Texas Agr. Exp. Sta.) Root rot of cotton, caused by the fungus *Phymatotrichum omnivorum*, is the most destructive disease of cotton in Texas. It is especially serious in the " black lands " where the heavy soils usually contain much lime. The present study was planned to determine whether the distribution of the disease in Texas is actually correlated with differences in the acidity or alkalinity of the soil.

Laboratory studies of the growth of the fungus on culture media showed that it grew best at about the neutral point, pH 7·0, and that it would not grow so well in more acid or in more alkaline media.

Cotton fields in sixteen counties of Texas were examined, and the acidity or alkalinity of the soil studied in relation to the presence of cotton root rot and also of Fusarium wilt. Root rot was found in acid soils (pH 5·5-6·4) as well as in neutral (pH 6·5-7·4) and alkaline soils (pH 7·5-9·0). However, in the alkaline and neutral soils the percentage of fields in which the disease was present was twice that in the acid soils, and root rot was also much more destructive in these fields than when it was found in acid soils. Fusarium wilt, on the contrary, was much more common on the acid soils. Hence it is probable that the differences in the distribution of these two important cotton diseases can be explained as due in part to differences in soil acidity.

416. STUDIES OF TEXAS ROOT ROT IN ARIZONA. By R. B. Streets. (*Phytopath.*, xviii., **11**, 1928. Abstr. from *Rev. App. Mycol.*, viii., **4**, 1929, p. 239.) Texas root rot (*Phymatotrichum omnivorum*) causes the greatest economic loss of any Arizona plant disease. In a two-year study of the life-history of the causal organism all attempts at conidial germination were unsuccessful. The fungus advances through the soil by means of rhizomorphs composed of a large central hypha enveloped by a sheath of finer mycelium bearing the typical slender, cruciform-branched appendages. Primary infection on cotton and lucerne usually occurs on the taproot 6 to 12 inches below soil level, and is effected by a combined wedging action of the hyphæ between the cortical cells, and by the penetration and filling of the adjacent cells with hyphæ. Selections from very severely infested fields of Pima and Acala cotton have been grown for two years on heavily diseased soil, and certain of the surviving progenies give promise of a fair degree of resistance. Soil sterilization with formaldehyde, organic mercury salts, carbon bisulphide, or sulphuric acid has proved effective to a limited extent.

417. THE INFLUENCE OF ALKALI IN SOILS ON THE PREVALENCE OF ANGULAR LEAF-SPOT IN PIMA-EGYPTIAN COTTON. By J. G. Brown. (*Abstrs. of Theses*, Univ. of Chic. Sci. Ser. IV. (1925-26), pp. 259-261, 1928. Abstr. from *Rev. App. Mycol.*, viii., **2**, 1929, p. 101.) Angular leaf-spot of Pima-Egyptian cotton is supposed to be less severe on alkali soils in Arizona. Investigations showed that sodium chloride, in concentrations sufficiently low to permit the growth of cotton, decreases the amount of infection in the Pima variety.

418. PARASITIC AND SAPROPHYTIC FUNGI OF THE DOMINICAN REPUBLIC. (Trans. title.) By R. Gonzalez Fragoso and R. Ciferri. (*Bol. R. Soc. Española Hist. Nat.*, xxviii., **7**, 1928. Abstr. from *Rev. App. Mycol.*, viii., Pt. 3, 1929, p. 200.) A species of *Nematospora* found on cotton (probably *Gossypium hirsutum*) seeds at Haina (Dominican Republic) was identified as *N. gossypii*. On various standard media, however, there was a sparse development of the yeast forms associated with *N. coryli* in addition to the normal mycelial mode of growth. Following up Guilliermond's suggestion for the exclusion of *N. gossypii* from genus *Nematospora* on cytological grounds, and its transference to the Hemiascaceæ, the authors here create a new genus *Ashbia* (a Latin diagnosis of which is given) with the type species *A. gossypii* (this genus has been anticipated by Guilliermond's *Ashbya* founded on the same species: see following abstract.)

419. RESEARCHES ON SOME LOWER ASCOMYCETES ISOLATED FROM STIGMATOMYCOSIS OF COTTON SEEDS. AN ESSAY ON THE PHYLOGENY OF THE ASCOMYCETES. (Trans. title.) By A. Guilliermond. (*Rev. Gén. de Botanique*, xl., 1928. Abstr. from *Rev. App. Mycol.*, viii., Pt. 3, 1929, p. 200.) A full account is given of the author's detailed morphological and cytological studies of *Spermopthora gossypii*, *Nematospora gossypii*, and *N. coryli*, which, especially the first-named, are considered to throw an important light on the phylogeny of the Ascomycetes.

N. gossypii is regarded as differing considerably from *N. coryli*, which, in the author's opinion, is closely related to the true yeasts. The former is a filamentous fungus referable to the Hemiascaceæ, and is made the type of a new genus, *Ashbya* (see preceding abstract.)

The bearing of these studies on the origin of the Ascomycetes is considered at length. The author places *S. gossypii* in the new family, *Spermophthoraceæ*, which he considers to be intermediate between the Phycomycetes and the Ascomycetes. In his opinion, the discovery of *S. gossypii* confirms Dangeard's view that the Ascomycetes are derived from the Phycomycetes.

420. Cotton Diseases of Special Importance in Tennessee, and their Control. By C. D. Sherbakoff. (*Circ. No.* 24, Univ. of Tenn. Agr. Exp. Station, 1929.) Anthracnose and angular leafspot are the most important diseases, and control by using two to three year old seed delinted with sulphuric acid is recommended. When Fusarium wilt is troublesome on sandy soils, only wilt-resistant varieties of cotton should be planted. On the black soils along the Mississippi River, Verticillium wilt is common; the use of disease-free seed and the rotation of cotton with alfalfa and corn may help to reduce the damage. " Rust " disease can usually be remedied by an application of 50 lb. of muriate of potash to the acre.

GENERAL BOTANY, BREEDING, ETC.

421. Studies of Inheritance in Cotton. By G. L. Kottur. In *Trop. Agriculture*, vol. v., **9**, 1928, Dr. S. C. Harland criticizes the results of Kottur's work (*Cf.* Abstract 149, vol. i. of this review), and states that in genetic analyses of a quantitative character, it is illegitimate to classify an F_2 into groups except with reference to points of minimum frequency, and then only in curves showing characteristic modality—bimodality for a 3 :1 ratio, or trimodality for a 1: 2: 1 ratio.

Mr. Kottur replies to this criticism in *Trop. Agriculture*, vi., **5**, 1929, and in a riposte attached, Dr. Harland adheres to his original contention.

422. Cotton Boll: Lock Number Inheritance. By H. Dunlavy. (*Biol. Abstr.*, 1928, **2**. Abstr. from *Summ. of Curr. Lit.*, ix., **6**, 1929, A. 4.) Data given show that seed from 4- and 5-lock bolls produced by the same mother plant produced plants having practically the same percentage of 5-lock bolls. The 4-lock boll progenies produced slightly more 5-lock bolls than did the 5-lock boll progenies. In another experiment, the highest producing (production of 5-lock bolls) plants gave rise to the highest producing progenies. For the years 1921 and 1924, the " high " progeny group produced 9·0 and 1·9 per cent. higher respectively than the " low."

423. Location of " Motes " in the Upland Cotton Lock. By H. E. Rea. (*J. Amer. Soc. Agron.*, 20, 1928, No. 10. Abstr. from *Exp. Sta. Rec.*, 60, **4**, 1929, p. 328.) A study of the locks of Anton cotton in 1924 and Belton cotton in 1925 and 1926 by the Texas Experiment Station, showed a progressive increase in motes (aborted ovules) from the apex to the base of the lock, the percentage range being from 6·5 to 25·3 for the 9-seeded locks of Anton, 11·1 to 38·5 for the 11-seeded locks of 1925 Belton, and 17·2 to 83·3 for the 11-seeded locks of 1926 Belton. Five-locked bolls averaged 19·2 per cent. of motes in Belton in 1925 and 4-locked bolls 16·8 per cent., while in 1926 the respective percentages were 27·5 and 20·5. The differences are suggested as nutritional or possibly due to incomplete fertilization.

424. Leaf Temperatures of Cotton and their Relation to Transpiration, Varietal Differences, and Yield. By F. M. Eaton. (*Tech. Bull. No.* 91, U.S. Dpt. of Agr., Washington, D.C. 1929.) From the summary we quote the following: This bulletin deals with the leaf temperatures of the cotton plant in the south-west. The experimental plants (Pima and Acala varieties) were grown at Sacaton, Arizona, as a part of a water-requirement series.

The leaf-temperature measurements were made by the thermo-electric method, in terms of the departures of the leaf temperatures from the temperature of the air. In measuring leaf temperatures, a leaf was folded upward in such a manner that two portions of the upper leaf surface were brought firmly together over one junction of the thermocouple, while the second junction, freely exposed to the air, was protected from the direct rays of the sun by two slightly separated slips of white paper. The thermocouples were connected by long extension wires to a galvanometer permanently mounted on a screened porch overlooking the experimental plants.

Leaves selected for similar exposure and age were found to vary in temperature. The variations were, in general, greatest during the hours of highest transpiration and of greatest intensity of climatic factors. The standard deviation of a series of forty-eight cotton leaves selected for similar exposure each hour throughout a day ranged from 0·301 to 1·280° C.

An average difference of 2·0° C. was found between cotton leaves nearly normal to the sun and leaves at an angle approaching 90° from the normal position.

Young leaves were found to be cooler than old leaves. A mean difference of 1·4 ± 0·25° C. was found in the temperature of leaves differing in age by three to five weeks.

Attention is called to the fact that over a six-year period the yields of Acala upland cotton have been relatively low at Sacaton during those years marked by an average maximum summer temperature above 100° F. The Acala yields averaged 40 per cent. greater during the three cooler years than during the years with average maximum summer temperatures above 100°. During the same six-year period, the alternate years of which had mean maximum summer temperatures above 100°, the yields of Pima Egyptian cotton fluctuated less, and the fluctuations showed no relationship to the mean maximum temperatures of the summer.

425. SAND-SOWING IN COTTON BREEDING. By G. Aboulela. (*Tech. and Sci. Serv. Bull. No.* 80, Botanical Section, Min. of Agr. Egypt, 1929.) Sand-sowing is a more successful method in cotton breeding than sowing the cotton seed with the seed of some other plant such as " Bamia " to help its germination. This method is very suitable to a dry climate. A hole depth of one inch, sowing with a small cone dibble, and the use of one seed a hole are recommended, also watering before and after sowing. The writer suggests the following method: " Water the ridges, leave them to dry to a ploughable condition (eight days in Upper Egypt, ten in Giza, and twelve in the North of the Delta, will probably be enough), sow with the small cone dibble at about two-thirds of the distance up the side of the ridge. Use dry seed, and water after sowing. The flow of water should be slow and the water level should be just below the line of sowing, in order that the holes shall be soaked by capillarity and not covered with water. This condition of watering is the best, but there is not much harm in covering the holes with water; a hole covered with water is preferable to one that is scantily watered. After a week or so the soil should be lightly fassed to get rid of the weeds, and care should be taken not to touch the sand-sown holes or to cover them with soil."

426. A METHOD OF WATER CONTROL FOR SAND CULTURES. By O. V. S. Heath. (*Ann. of Bot.*, xliii., No. clxix., January, 1929.) The construction and calibration of an apparatus for measuring the moisture contents of sand cultures is described. This apparatus consists of a porous porcelain candle full of water, buried in the sand, and with a mercury manometer attached. By calibrating the manometers in terms of sand moisture content, it is possible to measure the latter significantly to 1·2 per cent. of the weight of sand. If the apparatus is used for measuring the water uptake by a plant growing in sand culture, the accuracy must be much greater. It is suggested that this apparatus provides a satisfactory method of water control for sand cultures.

427. DEVELOPMENT OF THE COTTON BOLL AS AFFECTED BY REMOVAL OF THE INVOLUCRE. By T. H. Kearney. (Abstr. from *J. Agr. Res.*, vol. xxxviii., No. 7, 1929, p. 381.) Complete removal, by excision, of the involucres of Pima cotton flowers on the day of anthesis caused very significant reduction in the external dimensions of the boll, in the weight of the dry contents of the boll, in the weight of the individual seeds, and in the abundance of the lint.

The length of the period from anthesis to the opening of the bolls was shortened by three to four and a half days on an average. The more rapid drying of the walls of the boll due to full exposure to the light is believed to have been the chief factor in hastening the opening of the bolls deprived of involucres.

The reduction in the weight of the individual seeds was virtually the same whether the involucres were removed from only four flowers on each plant or from all flowers produced during a period of six weeks, an average of forty-eight flowers per plant. This suggests that the involucre contributes materially to the nutrition of the boll subtended by it, but little, if at all, to the nutrition of the plant in general.

The reduction, relative to the control (unmutilated) flowers, in the weight of seed cotton per boll, in the weight of the individual seeds, and in lint index was substantially the same whether the involucres were removed on the day of anthesis or about ten to fourteen days before anthesis. The inference is that these characters are controlled mainly by conditions prevailing after anthesis.

The mean number of seeds per boll was little if at all reduced by the removal of the involucre on the day of anthesis, but it was significantly reduced when the involucre was removed ten to fourteen days before anthesis.

In the former case the ovules were fully developed, and the removal of the involucre could have brought about a reduction in the number of seeds only by affecting fertilization adversely. In the latter case inferior nutrition due to suppression of the involucre may have rendered some of the ovules incapable of fertilization.

The effect upon the length of the lint was not determined in the experiments in which the involucre was excised on the day of anthesis, but excision at ten to fourteen days earlier resulted in reducing the mean length by nearly 3 mm., and the reduction was highly significant.

428. NON-DEHISCENCE OF ANTHERS IN PUNJAB-AMERICAN COTTONS. By Trevor Trought. (*Mems. of the Dpt. of Agr. in India*, Bot. Ser., xvii., 1, 1928.) A preliminary note of a phenomenon which is at present under investigation at Lyallpur, giving some details of observations made to date on the non-dehiscence of anthers in Punjab-American cottons.

429. MATERIALLEHRE FÜR DIE TEXTILINDUSTRIE. By J. Spennrath. (M. Krayn, Berlin, W. 10.) This work represents a useful summary of information upon matters connected with vegetable and animal fibres, and in many cases gives useful references to the literature.

In the first section (Plant Fibres) cotton takes pride of place, and is followed by a chapter on cellulose with its various reactions to chemical and other treatments, and by one on spinning and weaving of cotton. Kapok is dealt with, and a long list of fibres more or less frequently used for the same purpose as cotton, or for purposes for which cotton might be used. Information is then given in connection with the bast fibres, such as flax, hemp, jute, and the like, with a special chapter on the making of paper. The leaf fibres are also dealt with, the most important being the Manila hemp; and finally, the fruit fibres, such as coconut.

The second section of the book is devoted to Animal Fibres, such as wool, and there are final sections treating of mineral fibres (asbestos, etc.) and artificial silk.

The book forms a useful compendium of elementary information on the various fibres, and is well furnished with diagrams and illustrations.

430. FINE STAPLE COTTONS: CLASSIFICATION. By J. A. Todd. (*Man. Guar. Coml.*, 1929, **18**, 337. Abstr. from *Summ. of Curr. Lit.*, ix., **6**, 1929, M. 7.) Changes in world supplies of fine cotton are traced. Sea Island cotton has been very largely replaced by the Sakel varieties, which are now giving place to Uppers. Afifi has not yet found a successor of its own class, for Pilion has not commanded general acceptance. In this group also the old Delta staples of the Mississippi have been replaced, but not equalled, by the new staple Upland varieties. The greatest change has been in the Uppers group. The majority of the changes are in the direction of lower quality.

431. LONG STAPLE COTTONS: SUPPLY. By J. A. Todd. (*Text. World*, 1929, 75. Abstr. from *Summ. of Curr. Lit.*, ix., **3**, 1929, M. 4.) A subnormal demand for domestic and foreign long staple cottons, particularly for the middle range of such staples (1⅛ and 1¼ inches) has synchronized with a supply this season, including carry-over, that is somewhat above the average. Premiums on the latter are the lowest for many years, and there is grave danger that American, if not Egyptian, growers may be influenced thereby to curtail plantings in the coming season. The author explains and analyzes the conditions that have led up to the present situation, viewing them from the world standpoint, and emphasizing the fact that the only effective means of stimulating adequate yields of long staple cottons is the reasonable assurance to growers of adequate premiums.

432. CONTRIBUTION À L'ÉTUDE BOTANIQUE DES COTONNIERS. ATLAS ICONOGRAPHIQUE DU COTONNIER. By F. et H. Heim de Balsac. (Abstr. from *Coton et Cult. Coton*, 3, No. 2, 1928, p. 177.) Plate 16, here published, deals with the structure of the bud, flower, stamens, carpels and ovules of Pima cotton, and Plate 17 with the formation of the fruit.

433. SOME OBSERVATIONS ON THE MICROSCOPICAL STUDY OF DETERIORATED FABRIC FROM EARLY EGYPTIAN TOMBS. By A. C. Thaysen and N. J. Bunker. (*Biol. Abstr.*, 1928, 2. Abstr. from *J. of Text. Inst.*, xx., **4**, 1929, A. 176.) Fabric from the tomb of Queen Hetepheres, *circa* 3000 B.C., is reduced to a conglomeration of fabric fibre. A group of bodies believed to be fungus spores was found. Woody fibres are in various stages of preservation; cellular tissue, consisting of cellulose, is still present. Fabric from Tut-ankh-Amen's tomb, *circa* 1350 B.C., may possibly have been attacked by micro-organisms immediately after the closing of the tomb. The fabric has since decomposed by "ageing."

[And *cf.* Abstr. **320**, p. 262 above.]

CHEMISTRY AND PHYSICS IN THEIR APPLICATION TO COTTON PROBLEMS.

434. NOUVELLE MÉTHODE D'APPRÉCIATION DES QUALITÉS TECHNOLOGIQUES DE LA FIBRE DE COTON. (Abstr. from *Coton et Cult. Coton.*, 3, No. 2, 1928, p. 159.) Some years ago M. Heim de Balsac worked out a method for the appreciation of the various technological qualities of cotton fibre, but it required somewhat long and delicate measurement. In this article he describes the new method worked out by Roehrich.

435. COTTON HAIR: TESTING. By A. Herzog. (*Faserforschung*, 1928, **7**. Abstr. from *J. of Text. Inst.*, xx., **3**, 1929, A. 153.) Notes are given on the determination of staple length, fineness, wall-thickening, mercerizing power, presence of impurities, strength, colour, and lustre. Numerous photo-micrographs are given, together with tables showing the differences in the characteristics of mature, half-mature, immature and dead cotton hairs.

436. A METHOD FOR MEASURING THE "DRAG" OF COTTON FIBRES, AND THE RELATION OF CERTAIN PHYSICAL PROPERTIES OF THE COTTON FIBRE TO YARN QUALITY. By J. H. Moore. (*Tech. Bull. No.* 33, N. Carolina Agr. Exp. Station, 1928.) This report deals chiefly with the "drag" of cotton fibres and its relation to spinning value. ("Drag" is a common term used in the cotton trade, and is the resistance which one overcomes in grasping a sample of ginned cotton in the hands and pulling it apart.) An accurate method for measuring "drag" has been developed. Examination of fifteen bales of cotton resulted in finding two bales of similar grade and length which showed contrast in "drag," the ratio being 100: 145·4. The results of "drag" and manufacturing tests, and tests for strength of yarns carried out on these two bales are given, together with a study of the fibre development, ribbon width of fibres, and uniformity of fibre length. Results of spinning and "drag" tests on varieties of cotton from the 1926 crop of the State are also included. The data indicate that high strength of "drag" is not an important factor in yarn strength and the running quality of cotton.

437. COTTON OPENER. (A. Egli. Heidenheim, *Text. Merc.*, 1928, **78**, 514. Abstr. from *J. of Text. Inst.*, xix., **11**, 1928, A. 384.) The cotton is subjected to suction by means of the revolution of the opener, through a grid fixed below the opener in a box. This action prevents the loss of cotton, whilst dust and other impurities drop out. The box can be raised, together with the grid, thus altering the slit between the grid and the opener. Through the turning of the opener air is sucked into the space, the effect being increased by the closure of the grid at the bottom by means of the box.

438. COTTON OPENER. DESCRIPTION. (E. P. 295173 of December 16, 1927. J. F. White and P. and C. Garnett, Ltd., Cleckheaton, Yorks. Abstr. from *Summ. of Curr. Lit.*, viii., **22**, 1928, F. 47.) In a machine in which cotton, cotton waste, etc., is subjected to the action of a saw-toothed roller and drawn by suction through a shoot to a revolving cage, and in which a blade or deflector is arranged near the periphery of the saw-toothed roller, the entrance of the shoot is situated slightly in advance of the blade, etc. The opening can be regulated by a sliding door, and a partition is arranged below the blade to prevent foreign matter being drawn into the shoot. The fan is mounted on the floor to prevent vibratory movement being imparted to the blade. The revolving cage may be dispensed with and the cotton, etc., be drawn from the shoot directly through the fan and delivered as required.

439. COTTON OPENER. (*Cotton*, 93, 1928, 140-41. Abstr. from *Summ. of Curr. Lit.*, ix., **1**, 1929, F. 1.) In the system described there are five hopper feeders arranged so that they all deliver into the bale breaker. Thirty bales of cotton are arranged around the five hopper feeders, layers from six bales being fed into each feeder. These feeders in turn drop portions of their six bales on the feed apron of the bale breaker, so that by the time the cotton reaches the hopper of the bale breaker, a thirty-bale mix is secured at all times. Thirty additional bales are arranged similarly on a second floor, except that in the place of the feeders there are holes cut through the floor immediately over the hoppers, so that the feeders can be fed with cotton from the bales on the upper floor level through these holes. Thus while the cotton on the first-floor level is going into mill production, there are thirty bales opened on the upper level and vice versa. In this way the mill is always twenty-four hours ahead of its daily requirements, and the cotton has time to expand.

440. COTTON OPENING. (Text. Operative Executives, Georgia, *Cotton* (U.S.), 1928, 92. Abstr. from *J. of Text. Inst.*, xix., 12, 1928, A. 415.) A discussion of new methods of opening cotton which have been tried in American mills. The advantage of horizontal cleaners was pointed out. Results of various tests on waste from the different parts of an opener system were given, and it was shown that the Buckley beater is essential in a system of preparatory cleaning of cotton. In one mill great improvements in evenness per yard and in uniform weight of the breaker laps was obtained by installing a double breaker with a Buckley beater, eliminating the intermediate process but retaining the finishers. Questions of setting laps back were discussed.

441. COTTON OPENING AND CLEANING MACHINE. W. Newell and Brooks and Doxey (1920), Ltd., Manchester. (E.P. 298525 of July 9, 1927. Abstr. from *Summ. of Curr. Lit.*, viii., 27, 1929, F. 56.) The outlet for the cleaned cotton is adjacent to the feed inlet, and the grid covers more than half the periphery of the cylinder. A casing surrounds the grid, and is provided in the end walls with regulatable air inlets through which air is drawn by the suction through the outlet. This current of air carries back into the main stream fibres which have passed out between the bars of the grid.

442. COTTON: QUALITIES. By G. A. Sloan. (*Text. World*, 1928, 73. Abstr. from *J. of Text. Inst.*, xx., 2, 1929, A. 58.) The Cotton Textile Institute (U.S.A.) has published a booklet entitled "Qualities of Cotton" for distribution among manufacturers, distributors, growers, and educational and other institutions. The text of the booklet is given. It contains an account of the abundance and economics of cotton, its various uses and specific physical and chemical properties.

443. SPINNING. By S. Taylor. (*Text. Weekly*, 1928, 2. Abstr. from *J. of Text. Inst.*, xx., 4, 1929, A. 167.) A general account is given of the development of tests for measuring the characteristics of cotton hairs, and the results of investigations of opening processes, carding, and high drafting, at the Shirley Institute.

444. A NEW AUTOMATIC LOOM. (*Man. Guar. Coml.*, April 4, 1929.) Describes the loom invented by Mr. T. Toyoda of the Toyoda Spinning Company, Japan.

445. COTTON SEED AS A CATTLE FEED. (Abstr. from the *S. Afr. Produce Rev.*, October 12, 1928, p. 29.) Raw cotton is stated to be a most valuable and economical fat stock food. Given alone and without the correct amount of pasture and other natural feeds, however, it is useless as a quick, efficient economical feed, but in conjunction with a small amount of average pasture it has proved very successful.

446. BEEF STEER FEEDING EXPERIMENTS. I. COTTONSEED MEAL *v.* CRUSHED COTTONSEED FOR FATTENING STEERS. By A. F. Wande. (*Bull. No.* 42, Dpt. of Agr. S. Africa, 1928.) The differences shown in a series of experiments were too small to be significant, and it is concluded that it is as economical for a farmer to feed cottonseed meal as crushed cottonseed as a supplement in a ration for fattening steers.

447. COTTONSEED MEAL FOR MAINTAINING, GROWING, AND FATTENING HOGS. (*Texas. Sta. Rpt.*, 1927. Abstr. from *Exp. Sta. Rec.*, 59, 8, 1928, p. 768.) A lot of pigs fed cottonseed meal free-choice in self-feeders on oat pasture made good gains and showed no bad effects from the cottonseed meal. When pasture conditions are not favourable, however, this system is not recommended. A ration of ground milo, tankage, and cottonseed meal 87:4:9, with salt and limestone added, gave better results for fattening pigs than when an increased proportion of cottonseed meal was used.

448. Composition of Cottonseed Hull Bran. By K. S. Markley (*J. Amer. Soc. Agron.*, 20, 1928, No. 10. Abstr. from *Exp. Sta. Rec.*, 60, 4, 1929, p. 358.) From analyses of cottonseed hull bran, in which were determined, in addition to moisture and ash, the content of crude fat, crude protein, crude fibre, the nitrogen-free extract, the furfural yield, the pentose and pentosan calculated from the furfural, dextrose, sucrose, galactose reducing sugar after hydrolysis calculated as dextrose, and the same calculated as xylose, crude cellulose, and lignin, together with an analysis of the crude cellulose for ash, pentosan, alpha-cellulose and beta-cellulose, it is concluded "that cottonseed hull bran is a more valuable produce than was heretofore thought to be the case." Furfural amounting to 22·28 per cent. on the air-dry, or 25·39 per cent. on the oven-dry, basis; xylose with other pentoses amounting to about 40 per cent.; and crude cellulose amounting to 51 per cent., were among the products obtained.

CO-OPERATION.

449. The Co-operative Pattern in Cotton. By R. H. Montgomery. (London: 1929, Macmillan and Co. 10s. 6d. net.) A critical history of the co-operative marketing of raw cotton.

450. Needs of Co-operative Marketing in Agriculture in India. By R. D. Kapur. (Abstr. from *Agr. J. of India*, xxiv., 11, 1929, p. 117.) Deals with the subject as follows: Co-operative association and waste; Co-operation in connection with bargaining power, pooling, advertising, credit, and profits.

451. The Relations between the Departments of Agriculture and Co-operation. By A. P. Cliff. (*Agr. J. of India*, xxiv., 11, 1929, p. 102.)

LEGISLATION.

452. South Africa. *Regulations No.* 2056 *of November* 30, 1928, deal with the export of cotton lint and seed cotton overseas. *Regulations No.* 2174 *of November* 27, 1926, are hereby cancelled.

453. West Indies. St. Kitts and Nevis. (Abstr. from *Rpt. on the Agr. Dpt. St. Kitts-Nevis*, 1927-8.) *Statutory Rules and Orders, No.* 22, 1927. Requires all cotton seed imported from Nevis to St. Kitts for planting to be inspected by the Agricultural Superintendent.

Statutory Rules and Orders, No. 29, 1927. Appointing from January 1 to February 29 inclusive as the "close season" for cotton in St. Kitts.

Statutory Rules and Orders, No. 5, 1928. Appointing from July 1 to September 30 inclusive as the "close season" for cotton in Nevis.

HISTORY.

454. Les Centres de l'Origine des Plantes Cultivées. By — Vavilof. (*Bull. de Bot. appliquée et de Sélection*, xvi., 2, Leningrad, 1926. Abstr. from *Coton et Cult. Coton*, iii., 2, 1928, p. 139.) Asiatic cotton is said to have originated in South-West Asia, and American cotton in Mexico and Peru.

455. A Note on the Early History of Cotton. By A. N. Gulati and A. J. Turner. (*Bull. No.* 17, Tech. Ser. No. 12, Ind. Cent. Cot. Comm., 1928.) The summary is as follows. The purpose of the present note is to describe some samples of cotton materials unearthed during recent excavations at Mohenjo-daro, which lies in the valley of the Indus in Sind, some 200 miles rather east of north of Karachi. It is pointed out that references to cotton in early literature are very few, and that 800 B.C. must apparently be regarded as the earliest authenticated date of a specific reference to cotton. The archæological evidence shows that the samples of cotton itself retrieved at Mohenjo-daro are very much older than this, as the date which must be assigned to them is about 3000 B.C. Three samples are described; the first was a small fragment of fabric, measuring one-tenth of an inch by three-tenths of an inch, very much tendered and penetrated by fungal hyphæ, weighing 2 oz. per square yard, made from 34's counts, and containing sixty ends per inch and twenty picks per inch. The other two samples were small pieces of string found in earthenware: one proved to be a 24-fold cotton cord, composed of two cords each containing twelve strands of 18's counts; and the other, also a 24-fold cotton cord made by the twice doubling of 6-fold cords, the count of each of the six single strands being 14's. Photographs of these samples are given, and the photo-micrographs of typical fibres extracted from them.

One of these samples was examined in considerable detail in order to ascertain how the properties of the fibre compared with those of present-day cottons, with the further object of assigning the cotton, if possible, to a particular species of *Gossypium*. As a result of this examination, the tentative conclusion is drawn that the cotton is not of the *herbaceum* type, but of the *arboreum* type, although the evidence is insufficient for it to be identified as any particular one of the varieties into which Sir George Watt classifies the *arboreum* cottons.

One of the samples of string had a purple colour; a few tests made on this sample showed that the dyestuff which had been used was probably of the madder type.

MISCELLANEOUS.

456. AMANI INSTITUTE. By W. Nowell. (Abstr. from *Trop. Agriculture*, vi., **2**, 1929, p. 49.) A general account of the station, with its history, and suggestions by the author of the research work which may be undertaken there.

457. IMPERIAL BUREAU OF SOIL SCIENCE. The Imperial Bureau of Soil Science (one of the eight Bureaux the formation of which was recommended by the Imperial Agricultural Research Conference of 1927) commenced work on May 1 at the Rothamsted Experimental Station. Sir John Russell, Director of Rothamsted, is also the Director of the Bureau, and Dr. A. F. Joseph, lately Sudan Government Chemist, has been appointed Deputy Director. The functions of the Bureau include the collection and distribution of all research work of importance on soils to the British Empire, the assistance of research workers in the prosecution of their investigations in whatever ways it can, the bringing together of workers from different parts of the Empire (either by correspondence or in conference), interested in the same subjects, and to supply information generally which may facilitate the work of soil experts in the development of agriculture.

It is hoped that before long the Bureau will be in close touch with all soil investigators of the Empire, both at home and abroad, and that, by means of information-circulars and other methods, the results of studies carried on in one part of the Empire will be made available for all. Arrangements will also be made to supply information dealing with soil investigations in foreign countries, the results of which (owing to language or other difficulties) are not readily available.

458. Facilities for Advanced Study and Research in Agricultural Science and Cognate Pure Sciences in the United Kingdom. (H.M. Stat. Off., 1929. Price 1s. post free.) One of the publications called for by the Imperial Agricultural Research Conference of 1927. It contains particulars of:

I. Institutions carrying out agricultural research, with principal members of the staff, short appreciation of fields of research, and account of facilities for research.

II. University professors in pure sciences cognate to agriculture, arranged under sciences.

III. Professors, readers and lecturers in agriculture and cognate pure sciences at universities at which agricultural research and teaching are carried out.

459. An Explanation of Some Statistical Methods used in Textile Research. (British Cotton Industry Res. Asscn., Manchester. Price 2s. 6d.)

460. Market Statistics. Uses and Limitations. By H. G. Hughes. (*Text. Weekly*, 2, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., 4, 1929, M. 5.) The conditions which govern statistical examination and the main lines upon which statistical research is at present working are outlined. Conditions governing the demand for goods are discussed, and it is shown that carefully chosen statistical information can be made to throw light on the trend of economic movements in particular markets, and especially in markets for cotton yarn or cotton piecegoods. The sources of information are discussed.

461. Rational Development in the Organization of the Cotton Industry. By E. E. Canney. (*J. of Text. Inst.*, xx., 2, 1929, p. 23.) Deals with the subject under the following heads: Rationalization abroad; Rationalized British Industries; Special Considerations for the Medium-Section Spinners; Combination to reduce Costs; Internal Obstacles to Trade Recovery; Combination for Specific Objects; Salaries and Wages.

462. National Economic Questions and the Cotton Industry. By E. E. Canney. (*Text. Rec.*, xlvi., 552, 1929, p. 33.) Discusses principally the external costs-raising factors which are depressing the industry.

463. Raw Cotton: Oiling. Southern Textile Asscn. ("Cotton" [U.S.], 1929, 93. Abstr. from *Summ. of Curr. Lit.*, ix., 9, 1929, F. 8.) Experiences of American spinners suggest that oiling reduces waste, dust, and fly, and that any complaints can be traced to the use of more than about 0·5 per cent. of oil.

464. Science and the New Industrial Revolution. By H. T. Tizard, C.B., F.R.S. (*J. of Text. Inst.*, xx., 4, 1929, p. 79.)

465. The Weaver-Loom Balance. By A. Palmer. (Abstr. from *Int. Cot. Bull.*, viii., 27, 1929, p. 504.) An analysis of the work of a weaver.

466. The Lancashire Cotton Corporation. (Abstr. from *Text. Rec.*, xlvi., 552, 1929, p. 29.) Since its incorporation the Lancashire Cotton Corporation, Ltd., has not lost much time in getting to work. Following on the issue of a schedule outlining the conditions upon which offers by cotton mill companies to amalgamate will be received, it is officially announced that requests for valuations have been received from eighty-three companies. Valuations have been received from the official valuers for the first five mills, and four of these have been visited and approved by members of the executive, on the strength of which firm offers have been made on the basis laid down in the conditions of amalgamation.

467. The Problem of the Cotton Trade. By G. W. Armitage. (Armitage and Rigby, Ltd., Warrington and Manchester. 1s. Extract from the *Liverpool Express*, May 22, 1929.) "Everybody interested in Lancashire's cotton problem would do well to read this exhaustive and analytical inquiry into the slump which the cotton industry is experiencing. If we did not already know that Mr. Armitage is an expert in matters relating to cotton, this useful publication would acquaint us with the fact."

ADDENDA.

(Received on the eve of going to press.)

468. Empire Cotton Crops. A Year of Recovery. By J. A. Todd. (Abstr. from *Times Trade and Engineering Supplement*, May 25, 1929.) The bumper American crop of 1926 (*cf.* the Editorial in Vol. IV., 1927, p. 1) caused such a lowering of price that a good deal of the area then devoted to cotton was used for other crops, and a set-back occurred. But the effect was not so serious as it might have been, on account of the small American crop of the following year. The author points out that as the fluctuation in the American crop may be as great as 5,000,000 bales, a production of at least this amount of "American" type cotton outside of the U.S. is needed, while as yet the Empire is producing less than 500,000 bales, and the rest of the world about 1,750,000 bales. There is thus ample room for further expansion in Empire areas devoted to cotton. There are encouraging signs that this expansion is actually going on, and though the progress is slow it is comparatively sure, and we may look to see the price of cotton upon the market become gradually more and more stable.

469. Nigeria. Cotton Cultivation. (Abstr. from the *Half-Yearly Report of the Dept. of Agric.* to March 31, 1929.) *Northern Provinces.*—The crop per acre was about 25 per cent. below average, but in the Sokoto Province considerable extension is taking place in cotton-growing. Since the erection by the British Cotton Growing Association of the ginnery at Gusau in 1923-24 the purchases of cotton in Sokoto have increased from 2,500 to 7,300 bales. One result of this increased production is that the new railway which opened on January 1 appears likely to pay well from the first day. In regard to the discussion that has occurred in the past as to whether the advent of cheaper transport by the railway will lead to the replacement of cotton by ground-nuts, the Department is of opinion that these crops are competitive only to a very small extent, ground-nuts being a crop of sandy soils and cotton of heavier ones.

Daudawa Seed Farm.—As the result of the visit of Mr. Engledow and Col. French last year, the Corporation have decided to increase gradually the area of cultivation up to a total of 1,500 acres, if possible, which will enable 1,000 acres of cotton to be grown. This year 360 acres are under cotton and 130 acres under other crops. The farm is progressing very satisfactorily.

Southern Provinces.—The area planted to cotton in the current season appeared normal, and in spite of poor crops in some districts the yield per acre has generally been very good.

Ishan Cotton.—The quality of the 1928-29 crop was considerably better than that of the previous season, which deteriorated owing to the abnormally bad weather conditions experienced. The growers are mostly well satisfied with this cotton, and continued rapid increase in production is anticipated. Botanical work is being continued in order to maintain the present standard, and if possible produce a still better strain.

In the Niger and Benue Provinces intensive studies are being conducted by the entomologists with the object of deciding whether American, Improved

Ishan, or local native cotton is the best suited to the districts. These studies will be continued for another year before any conclusions are drawn; they are laborious, but they have proved of great value.

470. TANGANYIKA. COTTON CULTIVATION. (Abstr. from *Report of Dept. of Agric.* for year ending March 31, 1928.) The control by the Department of the distribution of cotton seed to natives continues to be justified by the maintenance of the high quality of the cotton produced in the Territory; 1,248 tons of seed were distributed to natives in 1928, as against 1,040 tons in 1927. The quantity of cotton seed estimated to have been planted by non-natives in 1928 was about 400 tons, as compared with 274 tons in the previous year.

For encouraging cotton-growing in new areas remote from ginneries and markets, a system permitting the nearest ginnery to buy at a ginnery post serving the area has been devised. Where no provision of any kind exists for buying, encouragement is given to the erection of pioneer ginneries of a simple type less costly than the ordinary ginnery. For matters connected with the erection of ginneries and cotton marketing, the assistance is now available of a Cotton Advisory Board, on which the cotton interests in the principal cotton-producing areas—Morogoro, Kilosa, and Mwanza—and the Government are represented.

Various experiments with cotton are described in the report, including variety trials, time of sowing, distance of sowing, topping, ratooning, and cutting back of cotton experiments, and an experiment on growing cotton with rice.

The principal cotton pests causing injury during the year were the scales *Pulvinaria jacksoni*, Newst., and *Ferrisia virgatus*, Ckll.; *Phenacoccus iceryoides*, Green, and *Saissetia nigra*, Neitn. The following parasites of cotton insects reared at the laboratory have been determined by the specialists:

Chelonus curvimaculatus, Cam.
Microbracon kirkpatricki, Wilk. } from *Platyedra gossypiella*, Saund.
Brachymeria olethrius, Waterst.
Microbracon recessus, Szep., from *Sylepta derogata*, F.
Bassus aciculatus, sp. nov. Brues. (MS.), from *Earias* sp.

Apion xanthostylum, Wagn., is not yet known. An apion breeding freely in the seed capsules of wild malvaceæ has been identified as *Apion pauli*, Fst.

Cotton-leaf diseases are stated to be widely distributed, particularly in native plantations. Leaf parasites observed were: *Pseudomonas malvacearum*, *Mycosphærella gossypina*, *Cercospora gossypina*, rust (*Kuehneola gossypii*), *Phyllosticta* sp., areolate mildew (*Ramularia areola*), and two Alternaria spp., including *A. tenuis*. Identifications were made during the year of the following fungi: Aspergillus, probably *A. phœnicis*, *Rhizopus nodosus*, *Nematospora gossypii*, and *Diplodia gossypina*. The following fungi have also been found: *Monilia sitophila*, *Cladosporium herbarum*, and *Aspergillus niger*.

471. COTTON IN EGYPT. THE SIXTH REPORT OF THE COTTON RESEARCH BOARD, 1925-27. This report covers three years, and has been somewhat abbreviated in order to keep the volume within reasonable limits. The Botanical Section is first dealt with, commencing with the comparison of new types of cotton with old. Among Uppers the wholesale propagation of Giza 2 and 3 is now going on, being considered to be justified by the results already obtained. Another new type, Giza 7, shows a still further improvement, and is accepted by graders as Sakel. Among Fine (Delta) cottons Sakel B and C have been discarded, while Garofalou, Sakha 3, 4, and 11 are all under observation, and present very valuable characters. Pedigree plot work and hybridization are being vigorously pushed. Growth and flowering records of the chief varieties have been taken, and work carried out upon root growth, topping, ratooning (*cf.* Abstr. 425 in Vol. V., p. 272), and water-take observations.

In the Agronomic Section a number of varieties have been further tested out. Maarad showed up well for earliness, for yield, and for ginning outturn, and was first for total commercial value. Experiments were also conducted upon watering, spacing, etc.

In the Plant Protection Section the chief attention was devoted to wilt (Fusarium)—with a study of four more or less immune varieties—to sore shin, to bollworm, and to other pests and diseases.

Part IV. (State Domains Administration) deals with the selection and propagation of seed, the main varieties grown being Domains Sakel, Domains Sakel 310, Nahda, and Maarad. Part V. is devoted to the Chemical Section, and many appendices, tables, and plates are included in the volume.

PUBLICATIONS RECEIVED

We have to acknowledge the receipt of the following publications for the Library:

From the Welsh Plant Breeding Station.

JENKIN, T. J.: *No. 1 Pure Lines of Hen Gymro Wheat.*

From the Dept. of Mycology, Rothamsted Experimental Station.

BRIERLEY, W. B.: *Professor W. Johannsen.* (Obituary notice.)

PERSONAL NOTES

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the colonies.

At the date of writing, the following officers are on leave in England from cotton-growing countries:

Ceylon	Mr. A. H. G. Alston.
Gold Coast	Mr. G. G. Auchinleck
„ „	Mr. N. P. Chamney.
„ „	Mr. H. A. Dade.
„ „	Mr. H. K. Hewison.
„ „	Mr. H. Nicholas.
„ „	Mr. W. T. Roo.
„ „	Mr. J. L. Scott.
„ „	Mr. J. E. Symond
„ „	Mr. T. L. Williams.
Kenya Colony	Mr. F. B. L. Butlor.
„ „	Mr. R. J. Tathbury.
„ „	Mr. H. Wilkinson.
Nigeria	Mr. W. E. Bassett.
„	Mr. A. J. Findlay.
„	Mr. J. L. B. Kincaid.
„	Mr. K. T. Rae.
„	Mr. R. B. Shorter.
„	Mr. E. H. G. Smith.
Northern Rhodesia	Mr. T. McEwen.
Sierra Leone	Mr. F. C. Deighton.
„ „	Mr. H. C. Doyne.
„ „	Mr. P. J. Moss.
Tanganyika	Mr. E. Ward.
Uganda	Mr. C. G. Hansford.
„	Mr. G. W. Nye.
„	Major N. G. Wright.

The following officers of the Corporation's staff abroad are on leave, or will shortly be arriving in this country:

Nigeria	Mr. G. Browne.
Nyasaland	Mr. J. V. Lochrie.
„	Mr. C. B. R. King.
South Africa	Mr. S. Milligan.
Sudan	Mr. M. A. Bailcy.
„	Mr. F. E. Kenchington.
„	Mr. R. Peto.
Trinidad	Dr. S. C. Harland.
„	Dr. E. J. Maskell.

Printed in Great Britain by Billing and Sons Ltd., Guildford and Esher.

THE
EMPIRE COTTON GROWING
REVIEW

VOL. VI. OCTOBER, 1929. NO. 4

SOIL EROSION

A VERY interesting address upon the development of tropical countries was delivered at the annual meeting of the Corporation by Mr. Stockdale, the Assistant Agricultural Adviser of the Colonial Office. His observations were of such importance in their bearing upon the future of our tropical and sub-tropical Empire that they should be closely studied by all who hope that that future will be full of steady progress and prosperity.

Among the important subjects which were brought up in the address, and with which we may perhaps deal at various times, was that of soil erosion, which plays a larger rôle than is always clearly understood. People who have not seen the rain fall in the tropics, especially in the monsoon countries that include so large a part of the Empire, are apt to picture it as something like the rain at " home." Our rain, however, except upon rare occasions, would be regarded there as a gentle drizzle.

If in England one clears a piece of land, the rain undoubtedly begins to wash it away, and to leach it, but at a rate that is hardly worth mentioning beside that which occurs in the tropics. There, a shower in which a whole month's English rain falls in a few hours is a common occurrence, and we have ourselves seen 10 inches of rain fall without a break in less than a day. Such rain rapidly washes away the surface soil, and leaches out the lower layers, so that in a few years after clearance the richest forest land may be reduced to the poorest possible condition.

The natural state of most of the land in the rainy countries of the tropics is to be covered with forest or coarse grass. In either case it is useless for general agriculture, but its soil is at the maximum degree of content of humus, plant food and water-retaining capacity (largely due to the humus) that occurs under natural conditions. These features—which, as everyone who works with agriculture in the tropics knows, soon diminish and largely disappear after clearance of the land—are the natural capital of the country. This capital should be conserved, not regarded—whether consciously or unconsciously—as something to be exploited until perhaps the land at the last must be abandoned (as one may see in many places). The real question is, how to get the best out of the land without destroying the natural capital more than can be helped.

It is possible to live almost entirely upon the capital value of forest land, and this is the underlying explanation of the type of cultivation known in Ceylon as chena, in India as jhuming, in Malaya as ladang, and by other names in other countries. It is found almost all over the world where population is thin enough to allow to each person a large area of forest land. The trees on a portion of this are felled and burnt, and on the rich forest soil, further improved by the ash, a couple of crops of cereals or other products are grown, and the land is then left to go back gradually to forest: it is again good enough to chena in ten to fifty years.

This is living upon capital purely and simply, for the land is abandoned as soon as it begins to become weedy, in order to avoid the labour of real cultivation. It is less trouble to chena a fresh piece of land. If population increase, however, as it has done for example in much of India and Ceylon, chena must perforce be given up and more real cultivation carried on. But this has, in such countries, to be done upon land where the natural capital, owing to reckless clearance, has been very much reduced. The result is poor and uncertain crops, varying considerably with the climate of the particular year (*cf.* article by Youngman in this volume, especially p. 43).

In districts where the people are more intelligent, or perhaps, to be more exact, where pressure of population has compelled them to take more care, one may see attempts being made to rectify this state of things, by green manuring, rotation of crops, mixture of crops, and even by the use of actual manures, though in general cowdung, which is almost the only available and cheap manure, is used as fuel, and so is largely lost. But there are distinct and recognizable attempts to put back something into the soil, or to equalize and minimize its rate of loss.

A state of things which is essentially very similar to this may be seen in most tropical regions opened up by Europeans in coffee, tea, etc. Largely through ignorance, they have used up the natural capital of soil, humus, etc., almost as rapidly as possible. Their planting of various crops has largely proceeded in "booms," in which there has been an insistent demand for land, and not sufficient foresight or knowledge on the part of the Government to curb this demand in the interests of future generations.

The result has been wholesale opening of land, usually in hilly country, where erosion proceeds more rapidly.* The heavy rainfall has caused tremendous erosion and leaching, and has led to the silting up of rivers, causing floods and stoppage of navigation. A heavy price has frequently to be paid by a country that has been opened up for planting—not so much at the time, as later, when the results of the mistakes that were made in earlier times begin to appear.

Just as with the native industries above mentioned, so the planting industry has been forced to resort to the use of manures, of green manures, of terracing to prevent wash, of drainage, and so on. But the Government can and should also assist, for example, by the provision of sufficient reserves of forest. In Ceylon, in early days, small strips of forest were left along the tops of the ridges, but they were so narrow that they were soon consumed for firewood, burnt, or otherwise rendered nugatory. However insistent be the demand for land, the Government should enforce the reservation of large areas in forest, in such a way as to prevent erosion (so far as possible), or the drying up of the streams in hot and dry weather, a common occurrence in such countries as Ceylon, where it adds greatly to the difficulties of water supply.

The provision of an officer for general service in the tropical and subtropical colonies, to deal with this whole question of prevention of erosion and of deterioration of soil, is quite worth the consideration of Government. But if appointed, he should spend a good deal of time in study both within and outside of the Empire, to see how the matter is dealt with, for example, in Java by terracing, etc., in China and Japan by the use of manure, etc., and in other countries in other ways. He should establish liaison with forest and irrigation officers, with engineers in charge of roadmaking, and others, and eventually with their assistance devise definite schemes for road, drainage, and forest reservations, and for all such matters which concern several departments (and which must therefore be carried out by definite orders from Governmental headquarters), in addition to working at the questions of manuring, green manuring, etc., which are the province of an agricultural department.

Nearly all countries which have been opened up for any kind of "planting" afford striking object lessons in what ought *not* to be done, and the newer colonies should profit by these lessons before it is too late, and should learn what *ought* to be done, and do it.

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* *Cf.* article by Ducker in this number, below, p. 380.

SWAZILAND REVISITED

BY

G. F. KEATINGE, C.I.E.

A VERY young country which is just starting on a career of development provides one with pleasing sensations which are not to be gathered everywhere. Even the occasional visitor can pose as an old-time settler as he surveys a brand-new railway station flanked by a hotel, police-station, and stores, and can say with a wave of the hand: "I rode through this place when it was all unbroken bush." Such were my feelings when I reached Gollel on the southern border of Swaziland, the terminus of the new railway. A leisurely train from Durban becomes still more leisurely as it goes north, and takes twenty hours to do the 250 miles; but the point is that it brings you safely to the southern border of Swaziland, which, three years ago, was so inaccessible as to be out of the picture for most economic purposes.

At Gollel you say good-bye to the railway and take off your hat to the Union Jack. A serviceable road lies in front of you, with concrete drifts over the rivers, permitting of motor transport, and a service of buses and lorries is at your disposal to take you through Swaziland. In this way has Swaziland been connected with the outside world during the past few years, and the question arises, How can it turn the new position to good account?

The problem is an agricultural one. Three years ago, in an article printed in this journal, I discussed the question of growing cotton and other rotation crops in Swaziland. The farmers were then suffering from two bad seasons. They are now suffering from five. Yet most of them are optimists, though some of them oscillate between optimism and pessimism according to the time of day and other causes. I suppose that the real pessimists creep away and meet a sticky end elsewhere.

The tract to be considered is the low veld, and consists of two strips running from north to south: the Lebombo flats on the east and the hilly country on the west. Speaking generally, the former has the advantage in the matter of soils and the latter in the matter of rainfall. It is with the former tract that I propose to deal. On a general consideration of the conditions, an opinion was expressed that the obviously suitable crop was cotton, and that other rotation crops could be discovered. How far has the experience of the past three years justified this opinion? As regards soils I propose to say little except that a further inspection of the soils in the Lebombo flats confirms my previous opinion of their great variety and high level of excellence. In the matter of rainfall the figures for the past three years are instructive. I give below the details for the rainfall and cropping at a spot in the Lebombo flats for the past three growing seasons:

RAINFALL FIGURES.

	1926-27	1927-28	1928-29
September	1·54	·66	2·01
October	·56	4·26	1·45
November	2·85	1·83	·83
December	1·34	3·94	3·79
January	2·81	6·87	2·98
February	1·94	1·97	2·39
March	1·92	2·17	4·00
April	·50	1·06	1·39
Total	13·16	22·76	18·84

The rainfall of 1926-27 was certainly scanty, and it would have required very rapid sowing in November and very good cultivation to bring through a cotton crop successfully. As a matter of fact the rainfall of 1925-26 had also been very short, and as most of the land now referred to had been broken for the first time in 1926 and well dried out in the process, there was very little carry-over of moisture. Most of the crop was sown in December, and there were bad breaks in the rains during February and March, so that the crop was a very poor one, and only averaged 41 lbs. of lint per acre. Jassid was present this year, and the damage done by it was appreciable. In 1927-28 there was a fair rainfall, and cotton sown in October should have had a good prospect of success. There was, however, a very severe attack of jassid which practically wiped out the cotton in January. It is worthy of note that 100 acres of Z1 cotton which is resistant to jassid gave an average of 460 lbs. of seed cotton per acre.

In 1928-29 the rainfall came very late. Effective sowing was hardly possible before the last week in December. The rains in January and February were just adequate, and good rain fell in March and again on April 2nd, when it came to an abrupt end. By the time that the planting rain occurred at the end of December the moisture of the previous months had almost dried out of the soil, so that the effective rainfall for the season was barely 15 inches, and the period of effective rainfall was little over three months. Most of the cotton sown was of the Z1 variety, which is resistant to jassid, but jassid did some damage to the non-resistant varieties. The cotton crop averaged 250 lbs. of seed cotton to the acre on an area of 2,000 acres, one half doing much better than the other half. The reason why one half did badly is not at present very clear, but the failure was certainly due in part to jassid attack and to a sandstorm which stripped the cotton plants in an early stage of growth. As regards rotation crops, ground-nuts averaged 900 lbs. per acre over an area of 1,200 acres, while maize, Kaffir corn and beans gave fair returns. These results are encouraging in that they show that profitable crops can be grown even on the short and restricted rainfall mentioned above, and also for the indication obtained that under such conditions the new U4 cotton will do much better than the varieties previously sown.

The conditions mentioned above refer to the flats close to the Lebombo mountains, and the situation is probably as dry as anything in Swaziland. Now how do these figures for rainfall for the past three years compare with previous records? It may be admitted at the start that previous records are very scanty and not always reliable, also that the rainfall is so local that authentic records for one spot do not necessarily apply to land situated at a distance of a few miles. Admitting this, however, I think that there can be no doubt that the last few years have been on the dry side. Everyone is of this opinion, and the rainfall figures at Kabutu for the eight years up to and including 1924-25 averaged 35 inches, while the average figure for the three succeeding years was only 22 inches, showing a falling off of 33 per cent. This experience seems to have been fairly general on this side of South Africa, and the effect on the soil of three successive years of deficient rainfall has been cumulative. The subsoil has been thoroughly dried out, and in some places large and well-established trees can be seen dying in numbers. Accepting this view, the rainfall, as recorded above, does not appear too bad. Moisture is admittedly the limiting factor, and it is certain that sowing is liable to be delayed for want of early rain, and that awkward breaks in the rain may occur at any time in the growing period, while the late rains necessary to enable the plant to set its crop may fail badly. To counter these adverse factors the farmer must give his soils the best tillage to enable them to make the most of such rain as does fall; he must be ready to sow his crop with the utmost rapidity as soon as moisture is adequate, and to retain the moisture by every device of soil or vegetable mulch that may be practicable. So far as the rainfall is concerned the optimists have had their faith severely tried; but I believe that their faith is justified subject to the condition that everything is done to make good use of all the rain that falls.

The cotton plant is very much at home in the Lebombo flats. It stands up wonderfully well to drought, and recovers rapidly when a favourable change occurs. Give it half a chance and it comes into its own. It is the observation of this fact by many farmers that has maintained their faith in cotton under the most depressing conditions and under the strain of financial losses. What, then, has checked cotton-growing in the tract? Undoubtedly the jassid, which for some years past has taken its annual toll, and in particular seasons has wiped out the crop, as was the case in the season of 1927-28. This danger has now been eliminated by Mr. Parnell's jassid-resistant varieties. But Mr. Parnell has done more for the farmer than this. His Z1 cottons certainly have the great merit of keeping the jassid at bay, but apart from this they have their limitations. In his new U4 selections, however, he is offering the farmer a very different plant. Not only does it resist the jassid, but it is a very free fruiter. It develops early, stands up to drought well, recovers quickly after adverse periods, and ripens its crop rapidly: a great list of virtues, to which may be added a high ginning percentage and a superior staple. Every cotton grower is clamouring for seed of this variety and keen to plant it.

Then there is the question of ratoons. Does it pay to ratoon cotton? The effect of ratooning cotton is that the season starts with the roots of the plant already formed, so that the plants are able to make use of the first rain that falls. With a good saturation in October-November the plant comes away on the early rain and is making good growth at a time when plant cotton is only being sown or is struggling with germination. This is a great advantage in economy of moisture, and if there are awkward breaks in the rain during February and March or an early cessation of the rain, the ratoon may save the situation, and has done so in some years. This, of course, is not necessarily the case in every year, for a series of light rainfalls early in the season may moisten the surface soil only and suit the young plant cotton with its shallow roots better than it suits the ratoon with its deeper roots. Still, ratooning certainly spreads the risks. It also economizes labour and extends the picking season, both useful features. It must be admitted that to keep cotton on the same ground for two years must tend to increase the danger from insect pests, and the matter needs careful watching; but, on the other hand, a ratoon properly used can act as a trap for red bollworm, which is probably the greatest insect danger now that jassid has been defeated. On present experience judicious ratooning may certainly be advocated for the dry regions, though much has still to be learnt regarding the best methods and times for cutting back the plant.

Rotation crops for cotton are also a matter about which there is much to learn, and as yet little to say. Maize is a gamble, though when it comes off it provides a valuable food for local consumption. Millets (Kaffir corn) stand up better to drought, and the quickly maturing varieties require to be well tried out. They also find a good local sale. Sunflower grows very well, and on retentive soil and with wide spacing gives a profitable export crop in most years. Five kinds of beans have been found to give good returns under varying conditions of soil and moisture. Safflower, a noted drought-resister, will grow. These are some of the crops that the experience of a few years indicates as likely to be suitable. Time will test this brief experience and will add to the list. Though cotton may well become the main money-making crop of the tract, there is no reason to suppose that the farmer will be driven to put all his eggs in one basket or to violate the laws of husbandry by ignoring rotations. In trying out such crops under local conditions the officers of the Empire Cotton Growing Corporation are rendering yeoman service to the settlers.

Last, but not least valuable, as an adjunct to cultivation the farmer can rely on cattle. The Durban market is now within reach, and the low-veld grass enables him to put fat cattle on the market at a season when the high-veld cattle are getting thinner daily. A dairy business, also, is springing up. Looking at the situation as dispassionately as my temperament will allow me, it seems to me to be full of promise, and I am content to rely on the ultimate justice of the soil.

Writing as a casual visitor to Swaziland, I cannot omit to say a word about the settlers themselves. Their endurance and resource under difficulties excite admiration, and their kindness and hospitality are striking even to one who has received kindnesses in many lands. The Swazis also must be mentioned. They are born herdsmen and handle cattle very skilfully, and with training become good ploughmen. To the stranger they are a never-ending joy, both in their sterner moods with their knobkerris, assegais and shields and general appearance of swagger, and also in their milder moods when they may be seen festooning their woolly heads with hairpins and observing the effect in a pocket looking-glass with rapt admiration.

The cattle, too, deserve a word: good, upstanding beasts, Africanders, with here and there a touch of Hereford. You take from them four years' patient service at the plough, and then convert them into beef with no shock to your conscience and with much benefit to your banking account.

Finally, I must mention the Lebombo mountains which look down upon you from above and delight the eye with their ever-changing colours, dark purple one moment, pale mauve the next, and bright green a few minutes later. It is on these pleasant mountains that the easy-going Swazis elect to live, and they alone; but when the railway links up from Komatipoort on the north to Gollel on the south, and the rivers that flow from west to east have been harnessed to irrigate the sun-baked flats, then these mountains will provide cool and accessible retreats for the toiling farmers in the warm and fertile valley below.

Received May, 1929.

THE WORK OF THE GENETICS DEPARTMENT OF THE COTTON RESEARCH STATION, TRINIDAD

BY

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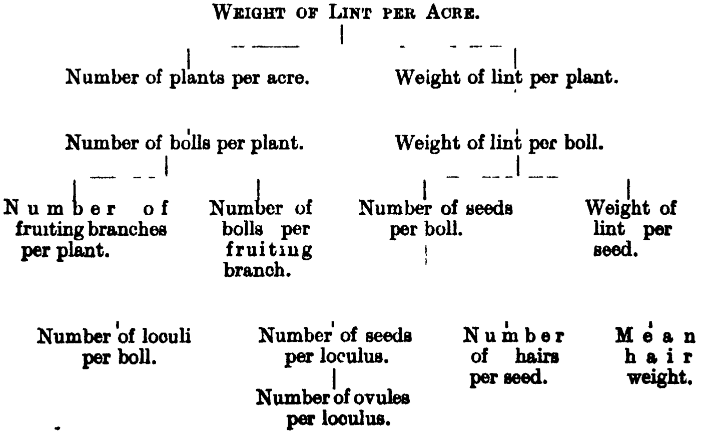
THE whole of the cotton industry centres round the fact that the cotton plant possesses convoluted or spirally twisted hairs on the seed coat. In the spinning process the convolutions enable the hairs to lock one into another, and to produce strong yarn. The hairs possessed by other plants are usually of the kapok type—*i.e.*, slippery and unconvoluted, and not suitable for spinning.

All scientific work with cotton thus concerns itself with the single cotton hair as a unit. The grower must consider the number, weight, and value of the hairs produced by unit area under cultivation, and the manufacturer the spinning, weaving, bleaching, and mercerizing properties, and the cost of the raw material.

As geneticists, we look upon the cotton plant purely as a machine for the production of cellulose in the form of unicellular seed hairs. Looking at the genus Gossypium as a whole, we conclude that the full possibilities of the cotton plant as a cellulose producing machine have not yet been attained in any one variety. The correctness of this statement will only be realized after a survey is made of the table below, in which *yield* is analyzed into its morphological components:


WEIGHT OF LINT PER ACRE.
Number of plants per acre.
Weight of lint per plant.
Number of bolls per plant.
Weight of lint per boll.
Number of fruiting branches per plant.
Number of bolls per fruiting branch.
Number of seeds per boll.
Weight of lint per seed.
Number of loculi per boll.
Number of seeds per loculus.
Number of ovules per loculus.
Number of hairs per seed.
Mean hair weight.

It will be seen from the foregoing that the final yield per acre is the result of the interaction of an extremely complex series of factors. Maximum yield will be obtained by the interaction of an optimum association of the above series of morphological factors with the environment. The environment provides another complex set of factors, and broadly includes climate and soil, insect pests, and fungoid diseases. With these, however, the present paper does not deal; but if, as a homely illustration, we liken the growing of cotton to a game of cards, then we may say that environment plays the cards that are dealt by heredity.

Let us consider some of the above characters in detail.

1. NUMBER OF PLANTS PER ACRE.

Much larger yields have been obtained in the United States by the adoption of the Egyptian system of close spacing. There is considerable evidence that optimum spacing differs with the particular variety, and it may be possible to select varieties which will tolerate very close spacing. Some Upland types can be planted 4 to 6 inches apart in the row, with rows 3 feet apart, but cottons of high node number and long vegetative period require wider spacing. There is much work to do on the spacing requirements of different genotypes.

2. NUMBER OF BOLLS PER PLANT.

The number of bolls per plant is affected by both morphological and physiological characters. Primarily it would seem to depend on the number of fruiting branches and on the number of bolls per fruiting branch. Both these have a genetic basis, but may be profoundly modified by environmental conditions. Liability to the shedding of bolls and buds, which may reduce the mean number of bolls per fruiting branch, is a character which is rather easily modified by selection, and it is a matter of mere selection to isolate shedding and comparatively non-shedding strains from any commercial variety. A type which is a shedder will respond to the loss of buds and bolls by producing more buds and bolls through compensatory growth, and such a type will show a greater development of fruiting branches than a non-shedder. Again buds and bolls, and sometimes whole-fruiting branches, may be destroyed by Black Arm disease. Susceptibility to Black Arm is genetic, and here again a large degree of resistance can be imparted to a type, either by plain selection or by crossing followed by selection. The attacks of plant bugs, notably the cotton stainer, cause great loss of crop by causing bolls to be shed, or to become infected with the fungi of internal boll disease or bacteria of various kinds. Evidence is accumulating that while no type of cotton is resistant to stainers, yet there are decided differences in palatability. Asiatic cottons grown alongside New World types are attacked very little, and certain tree cottons of the Peruvian type seem to be less palatable than Upland or Egyptian.

3. Weight of Lint per Boll.

Variations in this character are enormous. On the one hand, we have the wild species, *tomentosum*, *Sturtii*, and *Davidsonii*, producing no lint whatever on the seeds, and on the other, a new type of Upland which we have recently developed in Trinidad with 4·5 grammes of lint per boll. This type under good conditions of cultivation takes only 100 bolls to produce a pound of lint. At the spacing of 3 feet × 1 foot (14,520 plants per acre), this type is capable of yielding as follows:

Bolls per Plant.	*Lint per Acre in Lbs.*
1	145
5	725
10	1,450

The theoretical limit of boll size appears to be in a type with a 5-locked boll, 11 grammes of lint per 100 seeds, and eleven seeds per loculus. If a type can be obtained pure for this combination of characters, only seventy-five bolls would be needed to produce a pound of lint, and a yield of 193 lbs. of lint per acre would be obtained from only one boll per plant.

In many cases it is, of course, undecided whether it is preferable to have a large number of small bolls per plant, or a small number of large ones. Where conditions are favourable for the setting of a crop in a short space of time, the largest possible boll would appear to be of advantage, but where conditions are adverse it might be better to distribute the crop over a long period of time in the form of smaller and more numerous bolls. Even with small bolls, however, it is important to have a big weight of lint per seed.

4. Number of Loculi per Boll.

There does not seem any great obstacle to the production of strains breeding true to a 5-locked boll, or near to this value, in Upland, Egyptian, or Sea Island. The usual number in Egyptian is 3, with some 4's and 2's, depending on the strain. Whereas the Sea Island grown in Montserrat used to have practically only 3-locked bolls, it now breeds true to about 60 per cent. of 4's.

5. Number of Seeds per Loculus.

The number of seeds per loculus can be increased considerably above the present values found in commercial cottons. A Peruvian variety from Ecuador has from eleven to thirteen seeds per loculus, while Egyptian and Sea Island have normally five to seven. Different strains vary in the proportion of ovules which develop into seeds, and there is some evidence that genetic lethal factors are in some cases responsible for the death of 25 per cent. of the seeds.

Weaknesses of the Present Commercial Types.

Having dealt with the main morphological and physiological characters bearing on yield, we are in a position to indicate the weak points of some commercial types.

Egyptian.—The boll is too small, and the weight of lint per boll should be increased up to at least 1·2 grammes. In rain conditions it lacks resistance to Black Arm and to shedding.

Sea Island.—No type with a weight of lint per boll of less than 1·2 grammes should be grown. This has already been obtained by selection in the well-known Montserrat strain, H 23, developed by the late Mr. W. Robson in association with the present writer. Further progress can be made by the elimination of strains possessing a high percentage of undeveloped ovules.

Upland.—The boll is too small, as in the Punjab-American types, and resistance to Black Arm and shedding should be worked in. Resistance to jassids has already been obtained by Parnell and others in South Africa, where jassid is a serious pest.

The obvious criticism of what has been said above is that some at least of the far-reaching improvements suggested involve species crosses, and that all attempts which have so far been made to combine the desirable features of two distinct species, as, for example, Upland and Sea Island, have invariably proved unsuccessful. Experiments have often been tried to combine the large boll of Upland with the lint quality of Egyptian or Sea Island. The first generation hybrid is a magnificent type—vigorous, with lint as good as the superfine parent and bolls intermediate in size. In the second generation, a hopeless welter of mostly undesirable types is obtained, and even when selection is practised for three or four generations the desired type does not appear. For this reason, species crosses have largely been dropped as a method of improving the cotton plant, and workers have confined their attention to straightforward selection in a given commercial type.

Ordinary selection has both advantages and disadvantages. The great advantage is that as the type has presumably been grown in the country for some time, most of the really unfavourable genetic combinations have been eliminated, either by natural selection or by human agency. What natural selection could do is illustrated by imagining what would happen if the present genetic plots at the station were abandoned for ten years. We have a representative collection of types, both wild and cultivated, from all parts of the world, together with a lot of miscellaneous hybrids.

The situation at the end of ten years would probably be as follows: many of the South and Central American tree cottons would survive, as they are eminently adapted for competing with other vegetation, and to a long rainless period. Upland and Sea Island would fail to survive, though some of their hybrids would probably pull through. Only a few Asiatic types, like the Sennaar tree cotton from the Sudan, would be left. Roughly speaking, out of several thousand plants of widely varying genetic composition, only a hundred or two would survive.

The disadvantage of plain selection work is that very often the genes for the particular character desired are simply not in the stock at all, and no amount of selection can put them there. Thus it is doubtful whether immunity to Black Arm exists in Egyptian cotton. Probably as it is acclimatized to irrigated conditions with a dry atmosphere not favouring the disease, it has had no opportunity to accumulate genes favouring resistance. Sea Island cotton, on the other hand, has been grown continuously in a rainy country, and all types which get the disease badly have been eliminated by selection, both natural and artificial. Highly resistant strains have been developed in St. Vincent under a rainfall of over 100 inches annually, and under conditions of high humidity. The only absolutely immune type known to the writer, which offers promise as a means of introducing immunity to Black Arm into other types, is the wild species *G. tomentosum* from Hawaii. This type is so far absolutely immune under Trinidad conditions.

How is it possible to put immunity into Egyptian cotton and leave the rest of the Egyptian characters unchanged? The answer to this question is not at present available, and is capable of being given only after an exhaustive study of the genetics of both Egyptian and *tomentosum*. We have to know the genetic make-up of the immunity, and what the effects of the immunity factors are in different parts of the plant body. It may be that some of the immunity factors are closely linked with other factors which are undesirable. For example, the weak point of *tomentosum* is that it has no lint on the seeds, but only fuzz. If one of the important genes for immunity should be closely linked with a gene for no lint, or with the fuzz gene, it would clearly be impossible to transfer the immunity to Egyptian without at the same time transferring fuzz, or no lint. By genetic analysis, however, we shall ultimately be able to predict what combinations are possible. Meanwhile, our genetic studies lead us to believe that the best line of attack is to cross the F_1, which is susceptible, several times back with the Egyptian parent, using in each generation plants the progeny of which show segregation into immune and susceptible.

The transference of immunity from *tomentosum* to Egyptian would probably involve several major genes, each possibly accompanied by a number of modifiers. Altogether the number of genes to be transferred might easily be twenty or more.

According to modern notions of genetics, there are probably between three and four thousand genes, or hereditary factors in the genus Gossypium. These are present in twenty-six linked groups (chromosomes) in New World cottons, and in thirteen linked groups in Old World cottons. Our main aim, which may here be stated quite generally, is to work out the mode of inheritance of as many characters as possible in terms of genes, then to assign these genes to particular chromosomes and to particular loci in the chromosomes, and ultimately to utilize the chromosome map thus obtained in the synthesis of better cottons, both from the point of view of the grower and of the manufacturer.

If we had a knowledge of the chromosome map of the cotton plant, the task of synthesizing new cottons would be much simplified. It would then be possible to tell how strongly two genes were linked, and how frequently they would go together in the offspring, even if no previous experiment had been carried on to find out. Suppose there are three main genes for Black Arm resistance, and that these three genes are closely linked with three easily recognized genes—say for petal spot, yellow pollen, and yellow corolla. Then, as a rule, all the offspring of a cross which got spot, yellow pollen, and yellow corolla would also get the genes for Black Arm immunity. Here the genes for the morphological characters are serving as labels for the more difficultly recognizable physiological character. It is certain that all the important economic characters in cotton are represented by many genes, probably scattered at random over the twenty-six chromosomes. Though the construction of a chromosome map for cotton involves a lot of work and much laborious study, it is

evident that ordinary methods of cotton selection have nearly reached their limit in countries with a highly-developed cotton industry. Once the chromosome map is available, any strain of cotton could probably be corrected fairly rapidly in any of its weak points.

Programme of the Genetics Department.

It will be convenient to put down in simple form what the Genetics Department is aiming to do:

1. To make a complete collection of cottons from all parts of the world, both wild and cultivated.
2. To study the mode of inheritance of as many different characters as possible, in terms of genetic factors.
3. To use the information obtained under (2) for the construction of chromosome maps in both New and Old World cottons.
4. To utilize the chromosome maps for the synthesis of better types of cotton than those now grown, and perhaps to render cotton-growing commercially possible in regions where cotton is not at present grown.

THE COLLECTION OF COTTONS.

Country of Origin.	*Group.*	*Type.*
United States	Upland	Texas Green Lint.
		Dominant Naked Seed.
		Meade.
		Cluster.
		Red Leaf.
		Okra.
		Super Okra.
		Lint Index 104.
		Other commercial varieties.
	Peruvian	Egyptian Pima.
		Pima Spotless.
		Sea Island Naked.
Mexico	Wild	*G. Davidsonii*
Guatemala	Upland	Guatemala Khaki.
Colombia	Peruvian	Colombia 1.
	Bourbon	Colombia 4.
Peru	Peruvian	Tanguis.
Ecuador	Bourbon	Several.
	Peruvian	Several.
Brazil	Bourbon	Moco.
		Serido Golden.
	Peruvian	Kidney.
Trinidad	Peruvian	Red Kidney.
	Bourbon	Red Leaf.
		Cassava.
Tobago	Peruvian	Kidney.
Grenada	Bourbon	Two types.
Grenadines	Bourbon	Intense spot.
	Peruvian	Naked Seed.
		White pollen.

Country of Origin.	*Group.*	*Type.*
Martinique	Peruvian	One type.
	Bourbon	Five types.
St. Thomas	Bourbon	Two types.
Surinam	Bourbon	Several.
Jamaica	Bourbon	Jamaica Xerophytic.
	Peruvian	Jamaica Long Staple.
Cuba	Peruvian	Cauto.
Hawaii	Wild	*G. tomentosum.*
Fiji	Wild	*G. taitense.*
	Peruvian	Superfine Sea Island.
New Guinea	Peruvian	Kidney types.
Queensland	Bourbon	Port Essington.
Australia	Wild	*G. Sturtii.*
French Sahara	Bourbon	Air cotton.
Tanganyika	Wild	*G. Kirkii.*
Nigeria	Peruvian	Ishan.
Egypt	Peruvian	Enan's brown.
		Sakel.
Malta	Peruvian	One type.
	Upland	One type.
India	Upland	Punjab Golden.
	Asiatic	Many.
Burma	Asiatic	Several.
China	Asiatic	Million Dollar.
Turkestan	Asiatic	Several.
Transvaal	Asiatic	Rustenberg.
Sudan	Asiatic	Sennaar.

Since the Station started work in May, 1926, we have gradually accumulated a series of cotton types which is probably the most complete one in existence. The above is a provisional list, and contains principally the types which are being utilized in genetic studies.

SUMMARY OF WORK DONE.

Work began in May, 1926, with the transfer of a certain amount of material from the Imperial College of Tropical Agriculture. Since then the genetic plots, which cover ten to fourteen acres of experiments, have been got fully under way, and several thousand plants were examined in 1927 and 1928. A short summary of the information so far obtained follows.

Petal Spot.—A paper has been published in the *Journal of Genetics* (vol. xx., No. 3) on the inheritance of petal spot, both in inter-Peruvian crosses, and in crosses of Upland × Peruvian and Upland × Bourbon. Petal spot is controlled by factors providing a multiple series of allelomorphs. These manifest themselves in various grades of spot from the full spot of Sea Island down to the spotless condition of Upland. Inheritance is simple in Peruvian crosses, but in interspecific crosses segregation is obscured by modifying factors. Factors in the multiple allelomorph series appear to be:

S^s	Full spot of Sea Island and Egyptian.
S^i	Intermediate spot of Grenadines white pollen.
S^w	Weak spot of Trinidad Red Kidney.
S^f	Faint spot of Jamaica Long Staple.
S^e	Extinguished spot of Cassava.
S^o	Spotless of Upland.

Pollen Colour.—Yellow pollen of whatever shade is governed by a single factor P, which alone produces practically no effect, but which is raised to deep yellow by an unknown number of modifiers. The modifying factors can be carried by the p class, producing a series of shades of cream. Eight main groups of yellow are recognized, and four groups of cream. A paper on the inheritance of pollen colour has been published in the *Journal of Genetics* (vol. xx., No. 3).

Corolla Colour.—Here we have, again, two series of colours: a yellow group and a cream group. A simple factor pair, Y—y, is responsible for the two groups, but a series of modifiers produces a series of grades of yellow, and a corresponding series of creams. The full results will be found in a paper in the *Journal of Genetics* (vol. xx., No. 1).

Red.—Red Kidney and Red Bourbon contain a factor R, which converts green plant body to red. A factor having a similar effect has been described in Red Upland. We have not yet identified the factor in Upland with our R factor, though we have confirmed its monohybrid type of inheritance.

Leaf Shape.—The laciniated leaf of the Bourbon type, known as Cassava, shows monohybrid inheritance in Upland-Bourbon crosses. Evidence so far points to the existence of a multiple allelomorphic series of factors for leaf-shape with the following terms:

O^u	Upland leaf-shape.
O^c	Cassava leaf-shape.
O^o	Upland Okra leaf-shape.
O^s	Upland Super-Okra leaf-shape.

Super-Okra is a type with leaves showing greater laciniation than the ordinary Okra types.

Seed Fuzz.—Five factors have been identified governing the distribution of fuzz on the seed coat. These factors produce various types of fuzzy, tufted, and naked seeds respectively.

T The factor T produces a tuft on the apex of the seed, which behaves as a simple dominant to naked. Found only in the Peruvian group.

A	A dominant tufted factor found in Meade, dominant to the tufted of Sea Island, and to the fuzzy of *tomentosum*.
Z	A dominant fuzz factor found in most Uplands, dominant to Sea Island tufted, present also in *tomentosum*.
F	A fuzz factor dominant over Meade tufted.
N	A factor for naked seed found in Upland, completely dominant over all other forms of fuzz distribution.

In addition to these five factors, there are minor modifying factors concerned in producing gradations in the fuzzy and tufted groups.

An important discovery is that both fuzz and lint are not to be considered alone, but as part of the general hairiness mechanism of the plant. Thus both the factors T and N affect also the distribution of hairs on the base of the corolla. The general effect of T is to convert the seed from naked to tufted, to add 25 per cent. to the weight of lint per seed, and to put hairs on the base of the corolla. The dominant factor N acts as an inhibitor. It removes all fuzz from the seed, about 25 per cent. of the lint, hairs from the corolla base, and partly from other parts of the plant. In selecting hairy cottons for jassid resistance, it is probable that lint index and seed fuzz may be interfered with.

Chlorophyll Deficiency.—There are three factors controlling the ordinary green colour of the leaf, which may be called C^{ha}, C^{hb} and C^{hc}. Any of these factors are sufficient to produce normal green. The first factor is that contained in the Peruvian group, while the other two are found in the Upland group. The genetic constitution of the Bourbon group is not at present known.

Miscellaneous Characters.—The following factor pairs have also been identified:

G^l—g^l	Green lint—white lint.
K—k	Khaki lint—white lint.
C^r—c^r	Normal—Crinkled Dwarf.

Linkage Groups.—Several cases of linkage have been encountered In the first linkage group are apparently the following factors:

F (fuzzy), N^n (a factor for node number), S (petal spot), R (red), S^m (a petal spot modifier), and P^m (a pollen modifier).

The exact distances between these have not yet all been accurately mapped.

In the second linkage group are C^r (crinkled) and Y^m (corolla modifier).

In the third linkage group are P (yellow pollen), and B^l (a factor governing the number of boll loculi).

An interesting case of correlation was observed between G^l (green lint) and lint fineness. The green segregates are invariably finer than the white. Whether this is physiological or genetic correlation is not yet known.

Interspecific Crosses.—A large number of interspecific crosses have been attempted, and a number have been successful.

G. tomentosum, the wild species from Hawaii, has twenty-six pairs of chromosomes and crosses successfully with all New World types. Some of the hybrids are distinctly promising from the commercial point of view.

G. Sturtii, from Australia, also has twenty-six pairs of chromosomes, and can be crossed with New World types, although it is so distinct in appearance that it has been placed by some authors in another genus (Cienfuegosia). The hybrids are quite sterile, though it seems possible to use the hybrid pollen in back crosses with the parents.

G. Davidsonii is the only New-World species with thirteen chromosomes. It will cross with Sea Island, although the plants do not survive the cotyledon stage. It has also been crossed with *Stocksii*, the wild Asiatic species with thirteen chromosomes. The plants grew to about 3 inches in height and then died.

A cross has been made between the Indian type *sanguineum* and *G. Stocksii*. This flowers freely but is sterile.

We have so far not been successful in crossing New-World cottons with the ordinary thirteen chromosome Asiatic types, although Zaitzev and others have made this cross. The Station is in possession of one of these hybrids, however, through the kindness of Dr. Longley, of the Bureau of Plant Industry at Washington.

Received June, 1929.

MARKETS AND MARKETING IN NIGERIA

BY

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IN every large trading centre in the Southern Provinces of Nigeria there are stores of various European firms, which are usually known on the Niger as Factories—*i.e.*, Agencies. Each has a canteen or retail store, as well as a trading department, where goods are to be had in exchange for produce and not for cash.

To obtain raw produce the services of middle men, or more generally of middle women, are employed, who go or send to the local market, taking the pick of trade goods on credit. There are also numbers of stores springing up everywhere, kept by Sierra Leone, Lagos and other coast traders who take full advantage of the liberal terms offered them by foreign firms, and by understanding thoroughly and catering for local needs manage to do a considerable amount of profitable business.

In spite of every inducement to adopt the European retail system, the bulk of the inter-communal trade, and a good deal of the palm-oil trade in the first instance, is done by means of open-air markets.

In an Ibo town there is usually one large market-place, called an "Ilo," either centrally placed, or where there is a river, near the water and easily accessible to traders coming by canoe. It is a large cleared sandy space, varying from 100 to 500 yards long by 50 to 100 yards broad, flanked or surrounded by huge forest trees, and dotted with a few shade trees of the Ficus family. Rough sheds with palm-leaf mats or grass roofs, or light shelters made of oil-palm fronds, are built both in long rows and separately, for protection chiefly from the sun, and to a small degree from rain.

The week consists of four days, and the day on which the central market is held gives its name to the market—*e.g.*, to go to Eke Nkpo means to go to the market held at Nkpo on Eke day. There are other and smaller market-places in most towns, where evening markets are held, to which only the people of the immediate vicinity come, to exchange or buy small quantities of foodstuffs.

To the great weekly market, since the *pax Britannica* has been established, come men and women from places as far distant as sixty miles, when there is a shortage of food, carrying on their heads baskets filled with goods weighing up to eighty pounds. The men carry small fibre bags on their shoulders containing a few small yams or cobs of maize for roasting on an open fire in the middle or side of the road, a few pods of kola nut for chewing to stave off hunger, and a calabash cup or horn for drinking purposes. Each one has a cutlass or machete stuck in his girdle, and some carry long spears.

The bulk of the market people, however, live within a radius which enables them to leave in the early morning and return by nightfall. A walk along a road leading to the market in the early morning is full of interest. In seemingly endless procession and in single file, the market people come. The women carry on their heads oblong openwork baskets about three feet long by one foot broad and deep. The basket has a rigid bottom made with one piece of wood, into which the side uprights of round cane or wood are inserted, and strips of cane interwoven with a thick cane edge on each side. The baskets are filled and piled up with yams, cassava or bunches of plantains, and every corner stuffed with smaller items for sale such as herbs. Fitting over one end of some of the baskets are leaf-plaited coverings, rounded at one end and open at the other like a rigid cloak, to throw off the rain. A thick circular pad of grass or cloth protects the head and gives a steady seat to the basket, while one hand holds it in position. The weight of the loads is great, and the women's backs are so arched, through head-porterage from childhood, that they appear to be in danger of falling backwards.

Some of the men carry long, narrow, flat racks of palm midribs fastened together by cross-pieces of the same material, and on these heavy loads such as iron bars, metal pots and ornaments, bags of cowries, salt and kernels are tied. Here is a man with a basket full of pots of hard palm oil, and a couple of chickens with legs tied up and attached to the end; another has bags of palm kernels; one man has a goat and another a squeaking pig with feet bound together lying in the basket. Some men are leading cows by a long cord, or two or three goats by halters made of fibre, or a few dogs to be sold for killing. One man staggers under a load consisting of several bamboo poles about twenty feet long, another under a bundle of smooth palm midribs, while some have towering bundles of some 400 roofing mats made with plaited palm fronds. A woman carries a load of dried fish, commonly called "stink fish," which leaves a trail of smell for many yards behind her. Here is a woman with a bulky load of earthen water-pots which she has made, piled up and secured by a net or strings, a fragile burden which needs great care;

several men follow with loads of circular grass baskets. All the market people are talking hard in loud tones to their companions as they walk or trot along, and answering with a long-drawn-out "O" the frequent salutations of passers-by who call out "Nagbo" (Come home quickly), or "Neje ofuma" (Go well), or "Nnua" (Welcome). The huge circular plates of brass on the ankles of some of the women shine dazzling in the sun, and an occasional clang of the metal, as these barbaric ornaments touch each other, adds a note of rude music. Some have been resting, and are getting their friends to assist them to lift their loads on to their heads—a difficult matter to accomplish without help—and a woman deftly picks up with her toes something she has dropped, to save herself from stooping down.

Now take a walk to the market-place, when the market is filling up about 8 a.m. A mile or more away comes a roar of voices rising and falling like the sound of waves beating on the shore, the invariable sign of a market in progress. On entering the market-place, a scene of apparent hopeless confusion meets the eye. The sandy ground is covered with produce and goods of every description, and men and women are sitting or standing by them, so that it is difficult to pick one's way and to avoid treading on something or somebody. Yams are sorted and arranged on the ground in lots of a shilling or its equivalent. There are long pieces of sugar-cane stalks, piles of cocoe-yams, small cones of baked salt, little heaps of ground-nuts and capsicums; bundles of herbs, including bitter leaves, and spinach, and medicinal leaves and roots, arranged on shallow basket trays and calabashes; "heads" of tobacco, leaves of tobacco rolled up and tied round with fibre; round slabs of rock salt, called "Nnu Utaba" or snuff salt, from the North; and round balls of native soap. One sees kerosene tins, clay pots and bottles of palm oil. There are dogs alive and dead, goats, pigs, sheep, fowls, ducks, guinea-fowl, some in baskets and others with legs tied up together in a bunch, fighting with each other, and struggling for freedom and any scraps of food which come their way. Small lumps of cooked cornflour, called "Agidi," are tied up in a green leaf; and in one part Yorubas are cooking a kind of gruel made with maize flour, which is much appreciated. Some Hausa men are sitting before a fire of wood or charcoal, around which are arranged skewers stuck into little pieces of meat which are roasting. Awka blacksmiths sit behind rows of iron utensils which they have made. Of these there are iron hoe-heads of various patterns, wedge-shaped axe-heads, machetes, spear-heads, knives, triangular razors, nails, hinges, staples, gongs, sheep bells, circular three-legged stands for cooking-pot rests, brass chains for binding round the legs of young men, graduated brass spirals to adorn the legs of girls, solid circular brass plate anklets up to 15 inches in diameter, and each weighing about 3¼ lbs., for women, copper bracelets and anklets for men, and long ceremonial iron spears bound with brass and decorated with openwork centres made of twisted iron.

Hausas display their leather work, consisting of slippers, long boots, cushions, and fly whisks in red leather, and also dyed goats' skins. They have piles of Kano and other cloths, white, striped with blue, and some coloured a dark indigo and shining as the result of a process of beating with heavy wooden mallets. In one part the Hausa butchers cut up meat, and continually fan themselves and their meat to ward off the swarms of flies. It is as well to give a wide berth to this corner. There are bags, excellently made of fibre and leaf of all sizes, which may be bought for a few pence, as well as huge palm-leaf plaited rain hats and round baskets of plaited grass, cane, or of fan-palm leaves.

Among building materials are roofing mats made of palm leaves, round and adzed posts of all sizes, planks cut by sawyers from euroko trees, bamboo poles, and large bundles of cane.

Other produce includes pots, bottles, and kerosene tins full of palm oil, hard and soft, palm kernels, and dried fish. Lumps of sugar are arranged in small heaps on the tops of boxes, cigarettes in twos and threes, boxes of matches, biscuits in heaps, pop-corn and roast ground-nuts, rice, tins of fish, reels of cotton. There is a large quantity of Manchester cotton cloth in pieces of about six yards, lengths of rich satin brocade, tablets and bars of soap, lumps of blue, looking-glasses, short pieces of pipe coral—a much sought after ornament—belts, silk headkerchiefs, knitted woollen caps and jerseys, and women's underclothes. A Syrian trader displays his gaudy trinkets and silk embroideries. From under a palm-leaf thatched shelter comes the hum of a sewing-machine as the tailor makes jumpers and knickers, and outside, stretched on sticks, are suspended the garments for sale which he has made, the printed name of the firm being left on as an ornament.

In a corner are pots of palm wine with the froth of the fermenting juice flowing over their sides. The wine is of two kinds—viz., the sweet, drawn from the *Raphia vinifera*, and the medicinal flavoured juice of the oil palm, *Elæis guineensis*. Everyone tastes the palm wine before buying, and sometimes a man takes a good long drink to see if it has been mixed with much water, and whether it is fresh.

The rays of the sun beat fiercely on the heads of the market people, the dust flies about, the smell of perspiring bodies mingles with the competing odours of stink fish and palm oil, but nobody minds these things as they are only the concentrated essences of market. Local dogs and goats and chicken roam about in search of tit-bits, and vultures watch events from the branches of high trees, awaiting their turn when the market is over.

Follow a man as he walks round intent on making a purchase. He goes to a market woman selling stink fish and takes up a stick upon which a number of fish are fastened with their heads and tails together. He asks, " How much ?" and receives an answer. He offers half as much, and is met with an indignant refusal. He passes on to other sellers of fish and repeats the process, and then perhaps returns to the first woman, who asks a little less, and he offers a little more. After considerable chaffering he lays down his money, or his heads of tobacco, or piece of cloth, and takes the fish, satisfied because he has beaten down the price, and the woman satisfied because she has got the amount for which she really intended to sell. There is little or no buying in the European fashion, at a fixed price, although in reality everyone knows what is the market price for the day, according to the season and the abundance or scarcity of the commodities in the market.

To the European the chaffering seems uncommonly like quarrelling, voices are raised as if in a serious dispute, but a laugh reveals the lack of any ill-temper, or anything but passing and assumed indignation. The spice and pleasure of marketing would be removed, and there would be no outlet for the innate love of making a bargain if the prosaic methods of Europe were followed.

Soon after midday the marketers begin to disperse, and put their loads or empty baskets upon their heads and go home. The conversation on the homeward journey is all about prices offered and refused, and the satisfaction or otherwise at the result. Ask a market woman about her transactions, and she will almost invariably reply that the market had no " head," and that it was not good, meaning that she did not get what she expected, but this is for the most part " eye-wash." As the women near their homes, they are met by girls who have come out to relieve their mothers of the heavy loads and lead them home to partake in a well-earned evening meal.

The markets in the Northern Provinces in large centres such as Kano, Zaria, and Bida differ considerably from those in the South in that they are usually held in the evening, and when darkness falls, thousands of small clay lamps, filled with shea-butter, are lighted, giving a picturesque setting to the market-place.

In these markets there is a more orderly separation of the various commodities, and cloth will be found more or less in one place, pottery in another, and foodstuffs in another. There is always a capsicum or so-called "pepper" section, which is conspicuous because on approaching it everyone begins coughing.

The Northern markets are usually held every evening, as distinguished from the weekly markets of the South, though the custom of daily markets is gradually being adopted in the latter area in the large centres, chiefly through the influence of traders from the North.

Among the interesting features of marketing are the methods adopted for measuring and weighing goods in the absence of mechanical scales and standardized weights and measures. For measuring cloth, the unit of measure is tho "Obi" or breast—*i.e.*, the distance between the tips of the fingers of one hand and those of the other when fully extended. The distance also from the mouth to the tips of the fingers of one extended hand is reckoned as roughly representing the yard fold of a piece of imported cotton cloth. The span of the fingers and the length of the foot are commonly used for measurements. Square-faced gin bottles are employed for selling by measure liquids such as kerosene, coconut, ground-nut, and liquid palm oil. Kerosene tins are generally used as measures for hard palm oil. Salt bags are the favourite means of measuring kernels, as well as the most convenient receptacle for carrying them. Cigarette tins and milk tins are used for selling rice. The people, however, are clever at estimating capacity and weight by the eye, and by lifting, by which they are able to compare the weight with the amount capable of being carried upon the head.

An account of markets is not complete without some reference to currency. The basis of marketing is the exchange of commodities, but the people early discovered the advantage of fixed units of value. With the overseas slave trade came the introduction of cowry shells (*Cypræa moneta*), of two kinds, the small variety from the Indian Ocean and the larger from the East African coast. Although for many years no cowries have been imported by Europeans, the small cowry is still in great demand in most interior markets of the Eastern Provinces, while the larger sort has practically gone out of circulation. The value of the small cowry, naturally, has greatly appreciated, and there must be vast quantities of these shells buried in the ground which are brought out as required, to the great profit of the fortunate holders. Among the advantages of cowries over coins are the following:

(1) Their employment in purchasing small quantities of food and herbs and other articles of less value than the smallest coin.

(2) Their comparative cleanliness and non-corrosiveness.

(3) The important place they occupy in the social life of the people—*e.g.*, in paying cowries by instalments, and so leading to many visits in accordance with custom, instead of the payment down in a lump sum.

Another important form of currency on the coast arose from the introduction by the Portuguese of bracelets and armlets of metal called manillas (Portuguese, *manilha*, bracelet), which were used for the purchase of slaves, ivory, and palm oil. In 1505 Portuguese traders were buying slaves at Benin for twelve brass or copper manillas. Before the manilla was introduced, bars of iron, brass, and copper were brought in, and were fashioned by native smiths into personal ornaments which probably came to have more or less a recognized value according to the kind of metal and the workmanship involved. Later these rings of metal appear to have become conventionalized, and the writer has seen ancient rings of metal, copper, and alloy of local workmanship of over ½ inch in diameter, with overlapping ends which could never have been used as personal ornaments, and must have been used as currency. The Portuguese evidently took advantage of the prevailing custom of the coast tribes of making rings of metal, when they manufactured the manillas and imported them in large quantities to the Niger Delta and the Cross River areas. The common pattern is oval in shape, like the shackle of a chain, with lozenge-shaped open ends about 1¼ inches apart. The weight is just over 2½ ozs., and the value about 3d. each. But before this, however, there were manillas of larger shape, and some, at least, known as king-manillas, appear to have been made locally. The king-manilla of a very ancient type is a round bar of metal, either copper or an alloy, roughly 1 inch in diameter, oval in shape, 4½ inches deep in the centre, 9 inches between the ends, which were burred over, making a ⅜-inch edge. These rose-headed ends probably suggested the conventional lozenge-shaped terminations of the later stereotyped manilla.

King-manillas are carefully preserved by families, and are used in making payments of head-money for a bride in the Niger Delta. They evidently are regarded as possessing some particular "mana" or virtue in this connection. Manillas are still in circulation in the

Delta markets, although they have been demonetized and are no longer manufactured.

Another form of currency also in circulation in the South is the brass rod. It is about 3/16 inch thick, 3 feet long, and is doubled into the shape of a U for convenience in handling, and the value is from 3d. to 1s. 6d. according to the metal, thin copper wires in the same form also being employed.

In the north-eastern area of the Southern Provinces a most curious and unpleasant form of currency exists in small conventionalized iron fish hooks or spear-heads made by local smiths. Each is about ½ inch long by ⅛ inch broad, roughly barbed, and about 140 formerly were equal to 1d.

At one time in the writer's experience, it was very difficult to buy anything of much value without the use of trade gin, which was a recognized currency. Each bottle contained about 1½ pints of so-called gin, and was reckoned as 1s., though sometimes the market price was as low as 9d. The bottles were "square faced," and cost then, delivered on the coast, 4½d. per bottle, or 2s. 3d. per gallon.

Imported tobacco still holds a useful place as currency, and is found in every market. Formerly one "head," consisting of from three to five pressed leaves, tied round at the top with one of its leaves, and from 20 to 23 inches long, was worth 4d., but now 8d. or 9d. would be nearer the value.

Salt still holds a strong position as a currency in the Northern Provinces, and in the South also the price of goods is sometimes quoted in bags of salt. The value of these bags depends upon the distance from the coast, and varies from 5s. to 20s. and more, and cones of salt, made up and baked on tin plates over wood fires, are to be had for a small sum in most markets.

In the Royal Niger Company's territories, cash trade was not encouraged, and English coins were taken down to the coast and used to purchase goods which were brought back and sold.

The C.M.S. Niger Mission introduced the payment of wages in cash in the southern part of the Company's territory, and had silver coins sent from England to make payments; but labourers and agents were also issued tickets on the Niger Company for cloth, tobacco, and salt, which added considerably to the difficulty of keeping correct accounts.

Up to 1880 gold and silver coinage was in circulation on the coast, including English, Spanish, Portuguese, Russian, and South American; but in this year, at Lagos, all foreign silver coin was with-drawn from circulation. Maria Theresa dollars, bearing the date 1780, were used by Hausa traders, and were coined until about thirty years ago with this date on them, until they were demonetized and bought up by the Government.

The British Government introduced a metal currency throughout Nigeria. At first English coins were employed. A penny is called by the people generally "copper"; halfpenny, "half" or "half copper"; a threepenny piece "torro," because it was like the sound made to represent the attempt to pronounce three; a sixpence, "sisi"; and a shilling, for which an equivalent term for our unit of money is used. Then came the introduction of an aluminium tenth of a penny, and, in a kind of nickel, halfpennies and pennies with a central hole for stringing purposes. The "tenths" never "took on" in the South, and many of them were used as washers for corrugated iron sheets. Aluminium was found to corrode, and later nickel was substituted.

The coins of the West African Currency Board are to be found now in most markets, and gradually a metal currency is being adopted. In some of the markets in the South, if an English coin with the head of Queen Victoria upon it, is tendered, it is returned at once as "dead" money. This prejudice is not so strong in the case of a coin of King Edward's reign, possibly because it bears the image of a man's head with a beard, and is similar to those bearing the head of George V.

There is some difficulty in getting native traders to entrust their money to the banks. An enormous number of coins are buried, and so constant supplies of new coins have to be imported to make up for such withdrawals from circulation. One enterprising trading woman during the Great War used her iron water-tanks as money-boxes, and did a good deal of profitable loaning, even to Europeans, when cash was at a premium. During the same period, a paper currency from 1s. upwards was introduced, and those who had to force the notes into unwilling hands never wish to have that experience again, nor do they care to think of the disease that was propagated by such currency. One shilling notes could be bought by unscrupulous persons for 6d. in cash, and 10s. notes for 5s. and less, and the people were only too glad to get rid of the paper, which was liable to be eaten by rats and white ants, and often burned.

Markets in the Southern Provinces are not only a means of buying and selling and of exchanging commodities, they also perform a great social service. People go to market to hear the latest news and to meet their friends; women make their first appearance after childbirth, their bodies sometimes smeared over with a yellow powder; girls of marriageable age parade in all their finery of brass leg spirals, bracelets, beads, elaborate coiffures and bodies painted artistically in black designs; titles of chiefs are proclaimed and other social engagements fulfilled. A priest is often attached to the market, to whom dues are paid, and he makes laws for his particular market; and new markets are not opened before sacrifices to the local deities and deified powers of nature are performed. In one area a kind of market queen, called Omu, presided over each market, opening it by taking her seat on her stool, settling prices and disputes relating thereto, levying tolls and helping to administer justice or deal with cases affecting women, but now her post is only a nominal one.

One remark in connection with West African trade seems to be called for. Before the War, Germany, by studying at close quarters local needs, produced articles such as enamelled ironware, crockery, sewing-machines, and notably hurricane lamps as well as tiny metal kerosene lamps, and cloths of pattern which caught the eye, all at prices which led to an enormous demand. That demand is still strong, and Germany is well on the way to recovering her markets lost through the War. The British love of good solid stuff of all kinds which will last, is excellent for those who can afford to buy such commodities, but the West African native has little money to spend, his necessities at present are few, and to a much greater degree than is realized, European goods generally are of the nature of luxuries. To encourage him to spend his money he requires something to take his fancy, and each district needs to be studied and adaptations arranged to meet the particular need. The native also, very naturally, wants as much as possible for his outlay and is not much concerned if goods do not last a long time. The climate is of such a character that nothing, even the best, ever does last long, so he buys for the present and does not trouble about the future. West Africa is no longer a dumping-ground for surplus goods, where anything will do, and the attempt to make the people buy things because they are good, irrespective of the peculiar local prejudices, is doomed to failure. European agents have had to remove stocks of good materials from one area to another simply because the people did not like the pattern, or the colour was not just the kind that appealed to them. The local European agents are keen, capable men and generally may be trusted to know the sort of goods the people of their districts would buy, but their supplying firms do not appear to be always so adaptable and ready to meet the

FIG. 1. ONITSHA MARKET IN 1900

Facing p. [illegible]

FIG. 3. A CORNER OF KANO MARKET
(Raw cotton in foreground)

FIG. 1. CAMELS [illegible] [illegible] [illegible] HILL [illegible] KANO

FIG. [illegible] A CORNER OF KANO MARKET

FIG. 6.—BAGS AND CALABASHES.

FIG. 7.—CURRENCY.

Tobacco, Brass Rod, Manillas (including two old King Manillas of copper), Cowries (large and small).

Facing p. 3[illegible]

local needs as their keenest competitors in Europe. The Nigerian people of every tribe are born traders, and trading is the chief enjoyment of their lives. They respond amazingly to sympathetic understanding of their likes and their dislikes, and upon this expanding trade depends.

Received August, 1929.

Note on Figs. 6 *and* 7.—The picture of Bags and Calabashes shows the various native articles in use some years ago for holding marketable goods. In the centre is a cowrie stool, with a hollow cut in the middle of the seat to contain the cowries.

The other picture—Currency—shows various common types described in the article. To the left a bundle of tobacco leaves, then a brass rod (weight 9 ozs., length 3 feet), five manillas, and a lot of cowries (large and small). Two of the manillas are very old king-manillas, of copper with punched lines, rough and hammered out locally; their length over all is 11⅝ inches, thickness 1 inch, weight 4½ lb. The three small manillas are of bronze. The largest, which is an old type, weighs 6½ oz., the others 2⅛ and 2⅜ ozs. The last-named is the common pattern in present circulation; its value is about 3d.

COTTON IN NYASALAND

BY

H. C. DUCKER.

SINCE the first arrival of Europeans in Nyasaland, the fundamental problem or limiting factor hampering the country's progress has been the poverty of its communications.

The present port for Nyasaland is Beira in Portuguese East Africa, to reach which the Zambesi river has to be crossed. There is no bridge, and the substitute—a ferry—which is even now near the limit of its capacity, does not appear to be easily capable of improvement, since the great differences in level of the Zambesi during the rains and during the dry season are a constant source of trouble and expense, both to the ferry service and to the railway approaches. These difficulties naturally result in very high freight rates. Whether the ultimate solution will be a bridge over the Zambesi, or whether a new port must be found for Nyasaland somewhere in the vicinity of Quelimane, is at present unknown, but whatever happens the country cannot properly develop until a cheap and efficient route for exports to the sea is provided.

Within the country communications are also unsatisfactory. The railway terminus is Blantyre, some 100 miles from the Lake, and apart from some minor areas in which animal transport is possible, the presence of tsetse fly makes mechanical or carrier transport the only possible feeders. On the Lake are several small steamers, and apart from this there is no water transport available other than barges on the Lower Shire, a river which is only navigable during or just after the rains.

The result of all these difficulties has been to make Nyasaland one of the most backward of the African dependencies, and to confine crop production to those high-priced products which can stand the high freights. There has been little or no development of rational and ordered farming, and the agricultural history, so far as European estates are concerned, has been one of booms in various crops, followed by disastrous slumps when prices fell, and/or the usual train of pests and disease followed the extensive and continuous "planting" of the crops.

Cotton was first grown about 1900, and its cultivation on

European estates extended more or less rapidly until in 1917 the record crop of 8,600 bales was exported. Yields per acre, however, dropped steadily until, when prices fell, the cultivation became so unremunerative that it was practically abandoned. In 1926-27 the acreage sown on estates was negligible.

Owing mainly to a preferential duty on imports into Britain, tobacco took the place of cotton as the premier European crop. This in its turn is now threatened owing to the drop in prices due to over-production of Empire leaf.

Prior to 1923, cotton production by natives on their own gardens had never shown signs of settling down to anything approaching stable production, and in that year there was in fact a serious danger of the native industry dying out as the result of the upset caused by excessive variation in post-war cotton prices.

In May, 1923, the Government entered into an agreement with the British Cotton-Growing Association, the latter to have the sole right to buy native-grown cotton in Nyasaland for a number of years. In return for this they were to fix prices for each season at its commencement, at a level agreed to by Government. The agreement holds good until August, 1931, having been renewed last year.

The results have been admirable. Not only has the industry been saved from extinction, but the estimated total crop for 1929 is in excess of that of 1922, when European acreages were at almost their highest point in the history of the industry. The figures are of interest.

	In Bales of 400 Lbs. Each.		
	European.	*Native.*	*Total.*
1922	3,976	631	4,607
1928	292	4,164	4,456
1929	—	—	4,900 (estimated)

It will thus be seen that the production has changed over almost entirely from European to native growers.

The Association unfortunately lost money during the first five years of the agreement, owing chiefly to the drop in prices in 1926-27, the rates fixed and paid to the natives in those two years being higher than world prices justified.

Whether, when the agreement finishes in 1931, it will be possible without danger to the existence of the industry again to expose the native to the play of world prices one cannot say. It is, however, certain that the native is much more educated in the matter of price fluctuations than he was ten years ago, and that presumably having become well acquainted with the idea of growing an economic crop, he will not be easily discouraged.

Cotton has been grown in Nyasaland with more or less success at elevations from 4,000 feet above sea-level downwards, but it has been established by experience that the Nyasaland Upland variety, the survivor of the numerous types of cotton tried out when the industry was first started, does best at elevations below 2,000 feet. This means that cotton-growing on a commercial scale has become confined to the Shire Valley and Lake shore areas of Nyasaland.

Nyasaland consists of a long narrow strip of country contained in, and bordering, the part of the great rift valley of Africa which contains Lake Nyasa. Roughly, it consists of two stretches of plateau country bordering the long valley formed by the rift. This valley is itself divided into two main parts, the Lower Shire with elevations below 500 feet above sea-level, the Upper Shire and Lake shore areas with elevations ranging from 1,200 to 1,800 feet. The southern and eastern stretch of plateau country forms the Shire Highlands, with elevations for the most part between 2,000 and 4,000 feet, and chiefly differs from the northern and western plateau, which comprises most of Angoniland, in being lower by about 1,000 feet. The Shire Highlands are also wetter, having on an average about 40 inches of rain as against about 30 in Angoniland. The rift valley receives a rainfall about intermediate between these figures.

The whole country falls within the summer rainfall belt of southern Africa, and has broadly speaking two seasons only, a warm wet season in December to April, followed by a cool dry season. The hottest time of the year is just prior to the break of the rains.

It will thus be seen that cotton has to face in this country a wide range of conditions, and it is not surprising that the attempts made in the past to cultivate cotton of one variety, and to use much the same methods throughout such a range, have resulted in partial failure in some areas and complete failure in others, more especially when it is remembered that at elevations below 5,000 feet in the latitudes in which Nyasaland lies there is little or no frost of intensity sufficient to kill insect pests.

Soil types have had little influence on the distribution of cotton-growing, but there is a distinct tendency for alluvial types to be preferred to all others. These are mainly confined to the rift valley, but there are extensive patches of alluvium in the Palombe plain area of the Shire Highlands and around Lilongwe in Angoniland.

As a result of the unsatisfactory transport conditions, cotton has so far been grown within easy reach of the railway, and of the 4,456 bales produced in 1928, no less than 85 per cent. was produced in the Lower Shire area.

The possibilities for expansion are therefore considerable, when once the country is opened up by improved communications, and it is of interest to note that a survey for a railway extension from Blantyre to the Lake has recently been completed. If, and when, this extension is built there will be, it is presumed, improvements in the Lake steamer service, and the whole of the most promising cotton areas, those below 2,000 feet elevation, will be placed within easy reach of a main line of communications. In addition to this extension, the provision of a bridge over the Zambesi is also under consideration. Should this be built, or the possible alternative of a new port for Nyasaland north of the Zambesi be adopted, the chief obstacles to the extension of cotton-growing in Nyasaland will have been removed.

Research work commenced in 1923 and carried out by the Corporation during the past six years has provided results which indicate that there are possibilities for cotton in Nyasaland which past experience had barely indicated. The wholesale abandonment of cotton by European estates during this period in favour of tobacco, has given time for the work to be carried out with few outside distractions, since the Nyasaland Upland seed stock held by the B.C.G.A. has so far sufficed for the needs of the native growers of the Lower Shire.

As a commencement, a site for a station was selected on the Palombe plain at an elevation of some 2,000 feet. This it was thought would prove to be about the mean for the conditions of the cotton-growing areas.

Work for the first two years was confined to this station, Makwapala, and considerable information was gained about the behaviour of various strains of cotton under its conditions. A great deal of information was also gained about the cultural problems of a large range of possible rotation crops. Methods of cultivation were also studied and a number of implements new to the country tried out.

In 1924 work had so far developed that it was possible to test outside the station some of the results obtained, and for this purpose two small sub-stations were established, one at Liwonde on the Upper Shire, the other at Port Herald on the Lower Shire. Results obtained during 1925-26 indicated that conditions at Liwonde were too like those at Makwapala for the station there to be of much use, and it was closed. Port Herald, however, proved to be so dissimilar to Makwapala that it was thought advisable to raise this sub-station to the status of a separate station, and it has since remained such.

In 1928, in view of the possible extension of the railway to the Lake in the near future, attention was paid to the cotton-growing areas of the Lake shore region. Of these the largest and most important is the stretch of coast extending from Kotakota southwards round the south-west arm of the Lake. This area contains many patches of most fertile alluvium, and is well populated wherever surface water is available. It is considered that its potential cotton-growing area is more than twice as great as that of the Lower Shire.

It was found that the coastal areas showed conditions common to both Makwapala and to Port Herald, and yet were exactly like neither station, and it was thought that the importance of these areas was such that a small station (like that at Port Herald) would be justified. This has been sanctioned and an admirable site selected. Study of the cotton problems of the Lake shore will commence with the 1929-30 season.

The great weakness of Makwapala has proved to be its soil. This is of the residual type derived from the underlying rocks, metamorphic gneisses and schists, and though representative of the soils of a very large part of Nyasaland, its properties, taken in conjunction with the falls of the land, have caused soil erosion to interfere considerably with the work of the station. The dangers arising from soil erosion first became evident in 1926, and it has been necessary to ridge-terrace the entire station. This work was completed in 1928, and reasonably stable conditions have now been established. In conjunction with the torrential rains which occur in this country, the formation of a lateritic (ironstone) pan relatively impermeable to water has been in large degree a cause of erosion. Attempts are now being made to find ways of dealing with this pan. It is possible, however, that the difficulties at the station are an advantage in the long run, since it has appeared that cottons which will crop there will do even better when tried out under better soil conditions.

It has been found that Makwapala, instead of being representative of the mean of the country's cotton-growing conditions, is really representative of the high country conditions of the plateau areas. In these, to obtain a crop, cotton must be sown as early as possible, so that its crop may be well forward before the insect pests can develop to their fullest extent, bollworms and stainers being the most important factors in Nyasaland cotton-growing.

Port Herald, on the other hand, has been found to be an area in which cotton is best grown as a late-planted crop, since, unlike Makwapala, the cold weather conditions of this station are quite favourable to the plant's development. The Lower Shire cotton crop is made after the insect pests have become controlled by the seasonal changes in climate. The seasonal incidence of the various pests appears to be very much the same at both stations, and it is fortunate that the temperature-moisture relationships of the pests and their host do not appear exactly to coincide, and thus provide an opportunity for the cotton to " dodge " its pests.

We have the interesting condition of a winter and a summer crop of cotton within the 150 miles separating the two stations.

Jassid, of which so much has been heard in South Africa, is just as important in Nyasaland, and though it also can be " dodged " at Port Herald, it has been found advisable to grow a resistant strain even at this station.

It seems very probable that specialized strains suited to the sets of conditions represented by the two stations will be evolved, since the Over the Top variety developed by Makwapala from an importation from the United States, though distinctly successful in the plateau areas, has been a relative failure on the Lower Shire.

The Lake Shore areas which will be represented by the new Domira Bay station cannot yet be classified as either summer or winter crop areas, and it is not yet known whether a suitable variety will enable the Lower Shire practice of planting near the end of the rains to be adopted. This will be the first and most important piece of work at this station.

It would appear, from test plots sown this year, that parts of the Angoniland plateau will be found suitable for cotton, and that the strains and methods of cultivation evolved at Makwapala will be applicable. The climate of Lilongwe, though more extreme, is very similar to that at Makwapala, and has the advantage, moreover, that it is normally drier in April and May, months when drizzly weather frequently spoils the Makwapala crops by facilitating stainer development.

Work done on rotation crops has indicated that even the adoption of a two-course rotation will, to a certain extent, control the bollworms and stainers. It does not appear that at Makwapala the insect attacks have become greater in intensity since the station was opened, though cotton in either two- or three-course rotations has been grown every season since 1923. These results are of particular importance even now, since the native grower has in his food crops a ready-made rotation for his cotton. Once it becomes possible for the European grower to adopt sound and economic farming methods, which should be as soon as the internal and external transport conditions are improved, estate grown cotton should again come into its

own. In the meantime, there are possibilities in certain areas for cotton as a rotation crop for tobacco, and with the help of improved strains of cotton, one of which, Over the Top, has already been distributed, a number of growers have commenced a cotton-tobacco rotation.

* * * * *

The cotton situation in Nyasaland is at a very interesting stage. The improvement, in what is hoped will be the near future, of the country's transport system is likely to give rise to more diverse cropping, and the substitution of "farming" for "planting," and will result in an altogether more healthy economic state of affairs than has ruled in the past.

To meet these developments the Corporation expect to have ready tested strains of cotton suitable for the various sets of conditions under which cotton has been and will be grown, and approved methods of cultivation for these strains.

Received August, 1929.

A SUGGESTED METHOD FOR THE CONTROL OF CERTAIN BOLLWORMS IN COTTON

BY

S. C. HARLAND, D.Sc. (Lond.).

It has frequently been observed by cotton workers that although no one type of cotton is immune from bollworm attack, yet there are distinct differences in what may be termed the palatability of different species and varieties. Thus when New World and Old World cottons are grown side by side, the former are attacked by Pink Bollworm to a greater extent. Such differences are no doubt correlated with variations in the chemotropic properties of the different sections of the genus. That is, the moths are led to lay their eggs most abundantly on the plants with the most attractive odour.

The possibility of using other malvaceous plants as a trap-crop for cotton bollworms has often been considered, but unfortunately cotton seems to be almost always preferred as a food plant. Nevertheless, this line of approach to the problem of control still offers attractive possibilities. In the future it may be practicable to analyze the factors influencing palatability into their genetic components, and render wider the present narrow gulf which separates the relatively palatable from the relatively unpalatable cottons.

Meanwhile, a possible method of control appears to lie in the employment as a trap-crop of certain hybrids between members of the different sections of the genus Gossypium. Hybrids between New World and Old World cottons—*e.g.*, between American Upland and Indian types—have been made by several workers, and are characterized by complete sterility. Flowers are produced abundantly, but since the pollen and ovules are non-functional, the young bolls are invariably shed in a week or less. It follows that the larvæ of species of bollworm which require older bolls to complete their development will perish in the shed bolls. In the case of the Pink Bollworm, we have occasionally seen an almost full-grown larva in the open flower, but it is clear that practically no breeding up can take place.

The planting of patches of sterile hybrids is thus worth trying as a control measure, and experiments will be carried out in Trinidad during the coming season. In addition to the American-Asiatic hybrid, another hybrid is available—that between *G. Sturtii*, the wild Australian species, and New World types. This also exhibits complete sterility in F1. This cross is easily made under Trinidad conditions, though we have not succeeded in making the American-Asiatic hybrid.*

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* Plants of an American-Asiatic cross were obtained as rooted cuttings through the kindness of the United States Department of Agriculture.

Received August, 1929.

COMPARATIVE COTTON PRICES

BY

JOHN A. TODD, M.A., B.L.

We continue in this issue the record of comparative cotton prices.

As will be seen from Table I., although there has been very little change in the level of general prices, the average prices for the principal varieties of cotton show some reduction from those of the previous season. This is specially marked in the case of Indian, which is the more remarkable because the Indian crop last year was substantially smaller than in 1927-28, while the American and Egyptian crops were both larger.

The outstanding feature of the season was the really remarkable steadiness of prices; in Liverpool, for example, the range between the highest and lowest quotations for Middling American Spot was only 142 points against 350 in 1927-28 and 406 in 1926-27. Table II. gives the record of the movements of American and Egyptian spot prices during the past three seasons. With regard to American, the first Bureau report of the season, on August 8, was below expectations, but the market refused to believe it, and put prices down. The downward movement continued until September, when the lowest point of the season was touched (9·72d. on the 15th), but after the September report the market eventually became convinced that the crop was not going to reach the fifteen million bale mark as they had been expecting, and prices took a definite upward turn. From that time they remained more or less at the same level during the winter months, mainly as the result of the steadiness of the Bureau reports. In the spring, however, it became evident that the crop was making a bad start, and prices rose to the highest of the season (11·14d. on March 15). Then came a sharp reaction due to improved prospects for the crop, with anticipations of a substantial increase in the acreage, and, on the consumption side, reports of restriction during the last quarter of the season. When the acreage figure was published on July 8, however, it showed only a moderate increase, and this, together with reports of serious weevil infestation, put the market up again towards the close of the season. The rise continued into August, but when the first Bureau report of the new season was issued on August 8, it showed a figure appreciably larger than the average market expectation, with the result that prices again took a sharp turn downwards.

With regard to Egyptian prices, the movements during the season have followed those of American pretty closely, although Sakel has shown somewhat wider fluctuations which latterly brought premiums below the 60 per cent. level. The downward tendency of Uppers in relation to American has been even more marked, this being largely due to the great development of the Uppers crop in the last year or two.

Table III. gives the usual record of prices of certain other varieties, and it will be seen that the general movement of these is, as usual, almost entirely dominated by that of American quotations.

TABLE I.—HISTORY OF COTTON PRICES, 1899–1929.

SEASON'S AVERAGES.

Season.	*Liverpool Prices (Pence per Lb.).*					*Alexandria.*	*American Price of Upland*	*Index Numbers of General Prices.*	
	Sea Island.	*Brazil.*	*American.*	*Indian*	*Egyptian.*				
	Cents per Lb	Pornam Fair	Middling	No 1 Fine Oomra	F G F Brown	Dols per Kantar	Cents per Lb	Year	
1899–1900	16·70	5·06	4·87	4·40	6·81	12·28	7·60	1900	100·0
1900–01	16·40	5·50	5·16	4·37	6·87	13·80	9·30	1901	96·7
1901–02	19·30	4·87	4·78	4·19	6·31	10·42	8·10	1902	96·4
1902–03	*25·00	5·57	5·44	4·47	8·44	13·65	8·20	1903	96·9
1903–04	28·40	5·16	6·94	5·56	8·56	16·65	12·16	1904	98·2
1904–05	27·12	5·25	4·93	4·62	7·37	13·97	8·66	1905	97·6
1905–06	26·38	6·23	5·91	5·00	9·25	15·99	10·94	1906	100·8
1906–07	36·70	6·97	6·38	4·87	10·37	19·16	10·01	1907	106·0
1907–08	35·59	6·79	6·19	5·03	8·81	18·21	11·46	1908	103·0
1908–09	23·39	5·84	5·50	4·91	8·44	15·46	9·24	1909	104·1
1909–10	32·85	8·34	7·86	6·31	13·12	23·30	14·29	1910	108·8
1910–11	35·62	8·27	7·84	7·03	10·75	20·66	14·69	1911	109·4
1911–12	23·73	6·70	6·09	5·63	9·56	17·25	9·69	1912	114·9
1912–13	25·00	7·11	6·76	6·16	9·79	18·28	12·20	1913	116·5
1913–14	23·47	7·47	7·27	5·88	9·45	19·02	13·49	1914	117·2
1914–15	22·00	5·71	5·22	4·46	7·34	12·01	7·94	1915	143·9
1915–16	27·00	8·22	7·51	6·09	10·42	19·28	11·99	1916	180·5
1916–17	50·00	13·03	12·33	10·32	21·56	37·81	18·41	1917	243·0
1917–18	80·00	24·13	21·68	18·78	†30·97	38·52	28·86	1918	267·4
1918–19	65·00	23·96	19·73	18·13	27·85	37·20	30·36	1919	296·5
1919–20	—	30·00	25·31	19·23	60·34	87·81	38·21	1920	365·7
1920–21	—	13·24	11·89	9·20	30·24	34·50	16·08	1921	229·7
1921–22	—	11·40	11·37	9·60	19·75	34·28	17·78	1922	185·0
1922–23	—	14·62	14·92	11·14	17·29	30·71	24·06	1923	185·3
1923–24	—	18·20	17·66	13·35	21·55	39·79	31·67	1924	193·6
1924–25	—	14·67	13·76	11·95	29·82	39·49	24·27	1925	185·4
1925–26	—	11·09	10·77	8·97	20·05	30·47	19·88	1926	172·5
1926–27	—	8·32	8·15	7·18	15·39	21·49	12·96	1927	164·7
1927–28	—	11·36	11·17	9·21	19·39	29·68	19·72	1928	163·4
1928–29	—	10·72	10·52	8·03	18·14	‡25·90	18·92	1929	§160·5

* South Carolina.

† F. G. F. Sakel.

‡ Nine months' average. These figures are F. G. F. Brown till 1914, since then composite figures embracing G. F. Sakel, G. F. Ashmuni, and G. F. Brown.

§ Seven months' average.

TABLE II.—SPOT PRICES OF AMERICAN AND EGYPTIAN COTTON IN LIVERPOOL, ALEXANDRIA, AND NEW ORLEANS ON THE LAST FRIDAY OF EACH MONTH

Month.	*Liverpool.*					*New Orleans American Middling.*	*Alexandria F. G. F. Sakel.*	
	American Middling.	*Egyptian F. G. F. Sakel.*		*F. G. F. Uppers.*				
	Pence per Lb	Pence per Lb	Premium per Cent	Pence per Lb	Premium per Cent.	Cents per Lb.	Dollars per Kantar.	Premium per Cent.
1926–27.								
August	10·17	16·35	*61*	12·60	*24*	18·49	30·00	*62*
September	8·43	17·25	*105*	12·25	*45*	14·48	33·50	*132*
October	6·85	14·65	*114*	10·50	*53*	12·27	25·75	*110*
November	6·92	14·65	*112*	10·10	*46*	12·61	26·37	*109*
December	6·89	14·10	*105*	9·80	*42*	12·75	25·62	*101*
January ..	7·26	13·65	*88*	10·10	*39*	13·20	25·25	*92*
February..	7·77	13·85	*78*	10·80	*39*	14·06	26·00	*85*
March ..	7·82	13·35	*71*	10·45	*34*	14·20	26·00	*83*
April ..	8·35	14·60	*75*	11·60	*39*	14·95	28·50	*91*
May ..	8·94	16·75	*88*	13·10	*45*	16·06	32·37	*102*
June ..	9·08	16·95	*87*	13·30	*46*	16·49	32·75	*99*
July ..	10·05	19·60	*95*	15·10	*50*	18·33	37·87	*106*
1927–28.								
August ..	11·15	19·45	*75*	15·45	*39*	21·30	38·62	*82*
September	11·57	18·75	*62*	14·80	*28*	21·56	37·00	*72*
October ..	11·66	18·80	*61*	15·20	*30*	20·31	37·00	*82*
November	11·14	18·35	*65*	14·55	*31*	19·51	35·25	*81*
December	11·06	17·75	*61*	14·40	*30*	19·92	34·25	*72*
January ..	10·32	17·25	*67*	13·35	*29*	17·91	33·25	*86*
February..	10·40	18·25	*75*	13·55	*30*	18·51	34·50	*86*
March ..	10·86	20·15	*85*	14·60	*34*	19·27	40·25	*108*
April ..	11·61	21·15	*82*	15·55	*34*	21·08	41·37	*96*
May ..	11·46	21·55	*88*	15·05	*34*	20·46	41·75	*104*
June ..	12·49	21·30	*71*	15·30	*23*	22·63	40·75	*80*
July ..	11·73	19·70	*68*	14·20	*21*	20·92	38·87	*86*
1928–29.								
August ..	10·47	18·85	*80*	12·80	*22*	18·50	36·37	*97*
September	10·72	17·90	*67*	12·00	*12*	18·53	34·12	*84*
October ..	10·51	18·05	*72*	12·40	*18*	18·55	35·00	*89*
November	10·97	19·40	*77*	12·65	*15*	19·57	37·87	*94*
December	10·64	19·35	*82*	12·20	*15*	19·36	37·87	*96*
January	10·48	19·10	*82*	12·32	*17*	18·91	36·50	*93*
February	10·49	17·85	*70*	12·10	*15*	19·00	36·62	*93*
March ..	10·96	19·40	*77*	12·80	*17*	19·75	37·50	*90*
April ..	10·23	17·95	*75*	11·86	*16*	18·59	35·00	*89*
May ..	10·20	17·25	*69*	11·38	*11*	18·52	32·50	*75*
June ..	10·33	16·20	*57*	11·18	*9*	18·76	31·37	*67*
July ..	10·58	17·05	*61*	11·54	*9*	18·89	33·37	*77*
1929–30.								
August ..	10·58	17·25	*63*	11·75	*11*	18·85	34·87	*85*

TABLE III.—MONTHLY SPOT PRICES OF VARIOUS KINDS OF COTTON IN LIVERPOOL, 1926–29.

ON THE LAST FRIDAY OF EACH MONTH. FROM THE LIVERPOOL COTTON ASSOCIATION'S WEEKLY CIRCULARS.

(*For American in Liverpool and New Orleans—and Egyptian in Liverpool and Alexandria—see Table II.*)

Seasons.	*Tanguis (Good Fair).*	*Peruvian.*			*Brazilian Pernam (Fair).*	*West African (Middling).*	*East African (Good Fair).*	*Indian (No. 1 Fine Oomra).*	*Percentage of Indian on American.*
		Smooth (Good Fair).	*Rough (Good Fair).*	*Afifi (Good Fair).*					
1926–27.									
August ..	10·92	11·17	12·50	11·75	10·17	9·87	11·50	8·30	*82*
September ..	9·23	9·48	12·00	12·25	8·48	8·18	9·90	7·15	*85*
October ..	8·40	8·15	11·50	10·50	7·15	6·80	8·50	6·15	*90*
November ..	8·47	8·22	10·75	10·25	7·22	6·87	8·70	6·25	*90*
December ..	8·20	8·20	9·50	10·00	7·20	6·80	8·60	6·25	*91*
January ..	8·51	8·51	9·50	10·00	7·26	7·01	8·95	6·45	*89*
February ..	9·02	8·92	9·50	10·25	7·67	7·42	9·90	6·90	*89*
March ..	8·96	8·86	9·00	10·50	7·86	7·36	10·00	6·80	*88*
April ..	9·55	9·30	9·75	10·75	8·55	8·05	10·95	7·45	*89*
May.. ..	10·14	9·89	9·25	12·00	9·14	8·64	11·55	7·95	*89*
June ..	10·33	10·08	9·50	12·50	9·33	8·83	11·80	8·20	*90*
July.. ..	11·30	11·05	10·00	14·25	10·30	9·80	13·30	9·00	*89*
1927–28.									
August ..	12·25	12·00	11·50	15·25	11·40	10·90	14·40	9·65	*87*
September ..	12·67	12·42	12·25	15·75	11·67	11·17	14·60	9·85	*85*
October ..	12·66	12·41	12·00	15·50	11·66	11·16	14·35	9·70	*83*
November ..	12 14	11·89	12·00	15·25	11·14	10·74	13·90	9·25	*83*
December ..	12·06	11·81	11·75	14·75	11·31	10·91	13·80	9·15	*83*
January ..	11·27	11·02	11·50	14·75	10·52	10·12	13·00	8·50	*82*
February ..	11·45	11·35	11·25	15·25	10·60	10·20	13·10	8·60	*83*
March ..	12·21	12·11	12·25	16·25	11·21	10·81	14·00	8·80	*81*
April ..	12·86	12·76	12·75	16·50	11·86	11·41	14·80	9·40	*81*
May.. ..	12·76	12·66	13·00	16·50	11·76	11·36	14·65	9·20	*81*
June ..	13·79	13·69	13·50	16·50	12·79	12·39	15·70	10·00	*80*
July.. ..	12 98	12·73	12·75	16·25	11·98	11·58	14·50	9·10	*78*
1928–29.									
August ..	11·77	11·52	12·00	15·25	10·77	10·37	13·05	8·05	*77*
September ..	11·73	11·48	12·25	14·50	10·73	10·33	12·55	7·85	*73*
October ..	11·91	11·66	13·00	14·50	10·81	10·51	12·40	7·95	*76*
November ..	12·42	12·17	13·00	14·75	11·32	11·02	12·75	8·55	*78*
December ..	12·04	11·74	13·00	14·50	10·99	10·74	12·55	8·40	*79*
January ..	11·88	11·58	13·00	14·50	10·83	10·58	12·05	8·20	*78*
February ..	11·94	11·44	13·00	13·25	10·79	10·54	11·80	8·15	*78*
March ..	12·41	11·91	13·00	13·50	11·16	11·01	12·10	8·50	*78*
April ..	11·73	11·23	13·00	12·75	10·48	10·33	11·35	7·65	*75*
May.. ..	11·70	11·20	13·00	12·25	10·45	10·30	11·25	7·55	*74*
June ..	11·63	11·13	13·00	12·00	10·28	10·33	11·20	7·75	*75*
July.. ..	11·83	11·28	13·00	12·25	10·38	10·53	11·35	7·95	*75*
1929–30.									
August ..	11·68	11·28	13·00	12·50	10·38	10·53	11·10	7·95	*75*

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

472. **Review of the Agricultural Operations in India, 1927-28.** By D. Clouston. (Govt. of Ind. Central Pub. Branch, Calcutta, 1929). *Cotton:* During the year under review the area under cotton was 24,767,000 acres. The yield per acre rose from 81 to 95 lb. of lint, and the total estimated yield was 5,896,000 bales of 400 lb.

The work of the Indian Central Cotton Committee in the improvement of cotton marketing, prevention of malpractices, and the promotion of research for the improvement of cotton-growing, is described. An account is also included of the research work being carried out in the Provinces. In the section devoted to co-operative societies it is stated that there are 31 cotton sale societies in Bombay, of which 8 are in the Southern Division, 2 in Khandesh, and 21 in Gujarat. During the year under report they sold cotton of the value of Rs. 35 lakhs, distributed a large quantity of improved cotton seed, and earned a profit of Rs. 23,000.

473. **Indian Central Cotton Committee.** From the précis of the nineteenth meeting held in July, we learn that Dr. Clouston, the late President, has retired, and the meeting was addressed by his successor, Dr. McRae. Mr. B. C. Burt, late Secretary of the Committee, has been appointed Agricultural Expert on the Council of Agricultural Research.

The Cotton Transport Act came up for discussion, and the Chairman concurred in his predecessor's opinion that it should be accompanied by a thoroughly organized seed distribution scheme. Other matters discussed at the meeting were: the proposed amendment of the Cotton Ginning and Pressing Factories Act in connection with the marking of bales, cotton marketing, the prevention of various malpractices and abuses, the Egyptian Government scheme of loans, agricultural research, and the research scholarship scheme.

474. **Cotton in Bombay.** (Abstr. from *Ann. Rpt. of Dpt. of Agr. Bombay*, 1927-28, recently received.) The Department, with the aid of its own and private seed farms, can develop and control a new variety of cotton up to the stage when it occupies from 5,000 to 10,000 acres of land. Beyond this area it has been found essential to pass the work on to some other organization. Thus in the Karnatak an improved variety of cotton (Dharwar I.) has been spread and controlled up to 300,000 acres through the Hubli Co-operative Cotton Sale Society. Everything, however, ultimately depends upon financing the cultivator while his crop is still growing, and it is in this respect that co-operative agencies are apt to break down. This has been the experience of the Hubli Society, which was compelled to restrict its activities in the year under review to 144,120 acres. The area sown with the improved variety of Dharwar-American cotton (known as Gadag I) under co-operative control, has been 49,500 acres during the year. In South Gujarat co-operative agency has not developed to the same extent, but a special organization has succeeded in controlling about 11,856 acres sown with Hybrid 1027 A.L.F., during the same period, while the uncontrolled area reached 428,514 acres. In Khandesh more reliance for this work has been placed in the Taluka Development Associations, and the area sown with the improved variety known as N.R. cotton was estimated at 14,785 acres, whilst a beginning was made with the distribution of a superior spinning variety—viz., Dhulia I., with an area of 4,000 acres. In the Deccan Canals tract some 14,000 acres were sown with N.R. cotton, and in Sind the area sown with the improved Deshi variety known as 27 W.N. was 50,149 acres, and with the Punjab-American strain, 4F., 23,908 acres.

475. Cotton at Coimbatore. (*Admin. Rpt. of Cot. Exp. Sta. Kovilpatti*, 1928-29. Abstr. from *Digest No.* 82, Dpt. of Agr. Madras, 1929.) The season at Coimbatore was favourable for irrigated cottons, less favourable for rain-grown cottons, and distinctly unfavourable for cereals and pulses. Cambodia strain No. 440, now called Co. No. 2, did very well, and with proper treatment this strain will give an average yield of 1,000 lb. of kapas per acre for the season. This variety has been distributed to the ryots, and a large stock of seed is being raised on the seed farms. Experiments show that September 1 is the best sowing date. This not only results in bigger yields, but picking begins earlier and the cultivator is relieved of the necessity for irrigating the plants at a time when water is apt to be scarce. The popular belief that the growing of Karunganni cotton affects the cereal crops following more adversely than the growing of Uppam cotton was not confirmed by experiment.

476. Cotton in the Punjab. (*Rpt. of the Operations of the Dpt. of Agr.*, Punjab, 1928, Pt. I, p. 4.) From this report we learn that the most important line of research undertaken was an investigation into the periodic failures of the cotton crop, which have caused enormous losses to farmers in the province during recent years. In the year under report there was a local failure of cotton, particularly of American, in the Lower Bari Doab Colony, beginning in the neighbourhood of Okara and getting worse in the direction of Khanewal and Multan. The Director believes that these failures are due to a kind of "heat stroke," and he has appointed a committee of specialist officers of the Department to examine the problem in all its aspects. He is also arranging to have meteorological apparatus installed in the principal farms for the recording of climatic data. The labours of this committee are still in progress, and the results are awaited with interest.

Cotton research is conducted by the Cotton Research Botanist, Mr. Trevor Trought, who had 76 Desi and over 100 pure line American cottons under examination, but no new American type of any great outstanding value was discovered. A Desi type, *G. sanguineum*, is promising, and has been given over to the British Cotton Growing Association for trial. The white-flowered Indicum cottons, Nos. M-60-A-2 and M-62-C-1, evolved at Hansi, gave good results in south-west Punjab. M-60-A-2 gave the record yield of 37 maunds, 19 seers of kapas per acre at Sirsa.

The Department sold 31,000 maunds of improved seed to the farmers. The area under improved cottons amounted to over 1,150,000 acres, but as the Director has pointed out, the Punjab farmer does not get the profit which he should be getting by using improved varieties, owing to the extensive mixing of types which goes on at the ginneries. The Director has suggested that the only satisfactory solution of the difficulty lies in providing machine-tests (as it is impossible to estimate by hand-tests the amount of cotton of inferior quality contained in a sample of what purports to be pure American), and in selling on a certificate of quality. Further investigations are being made into the feasibility of this scheme.

477. Increasing the Yield of Cotton. By Trevor Trought. (Abstr. from *Seasonal Notes*, Punjab Agr. Dpt., vi., 1, 1929, p. 19.) Mr. Trought suggests that in order to improve the yield of cotton, small farmers in the Punjab should make use of ploughs for preliminary cultivation; use more seed for sowing; sow in lines; thin out superfluous plants, and resow where germination has failed.

These methods are in use in other countries, and the author is of opinion that their employment might prove of distinct value under Punjab conditions. The usual difficulty—of bringing knowledge home to the small farmer—crops up, and it is suggested that the large farmers should act as intermediaries.

478. INDIA. By Sir William Himbury. (*British Cotton Growing Asscn.* Price 1s.) An interesting account of a visit to India, dealing chiefly with the work of the British Cotton Growing Association farm at Khanewal. An account is also included of the progress of the work on the Lloyd Barrage at Sukkur, Sind. The report is well illustrated.

479. PUBLICATION OF COTTON STATISTICS IN THE INDIAN TRADE JOURNAL. (*Ann. Rpt. of the Ind. Merchants' Chamber,* 1928, p. 487.) The number of bales of cotton pressed in factories in British India and in those Indian States which furnish returns, has hitherto been published weekly in the *Indian Trade Journal.* In order to bring them to a figure which will allow of comparison with the Government forecasts—which are given in bales of 400 lb. net—the Provinces agreed to report weekly to the Director-General of Commercial Intelligence and Statistics, Calcutta, the approximate average weight of the bales pressed during the week. The number of running bales converted into the statistical bale of 400 lb. is now published monthly in the *Indian Trade Journal.*

480. IMPORTATION OF COTTON SEED. (*Commerce,* Calcutta, June 15, 1929.) The importation of cotton seed into India is at present prohibited except after the fumigation of the seed, and importation may take place only at eight prescribed ports, Calcutta being one of these. The Indian Central Cotton Committee have recommended the further restriction of importation to a single port, their view being that such a measure is desirable to obviate the risk of the introduction of a new cotton pest in the seed. They consider, in fact, that the importation of cotton seed for commercial purposes is unnecessary, and they point out that imports are small in quantity. The Government of India propose to give effect to the suggestion, and to order that imports of cotton seed shall be permitted only into the port of Bombay; and further, they propose that importation should be allowed there only for experimental purposes, by certain specified officers, in quantities not exceeding 100 cwt. in any one consignment, and, as at present, only on fumigation. The Government of Bengal having invited an expression of the opinion of the Bengal Chamber of Commerce on the proposals, the committee, after consultation with the interests concerned, have replied that they do not take exception to these.

481. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS. By A. J. Turner. We have received from the Indian Central Cotton Committee a copy of a report on the cotton named below. The particulars include Agricultural Details, Grader's Report, Fibre Particulars, Spinning Tests, Remarks and Conclusions.

Dharwar I. (*Kumpta*), 1928-29.—Area under cultivation in 1927-28, 152,000 acres. The cotton shows very little variation during the six seasons 1923-29; it is described as suitable for 34s warp.

482. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS, 1929. By. A. J. Turner. (*Tech. Bull.,* Ser. A., No. 12, 1929.) Reports are given on twenty-one standard Indian cottons and three American cottons tested for comparative purposes. Each report is divided into the following five sections: Agricultural Details, Grader's Report, Fibre Particulars, Spinning Tests, Remarks. The reports are prefaced by a note which describes the objects of the tests as being, generally, to accumulate data for the investigation of the methods of determining the quality or intrinsic value of a cotton, and specifically: (i.) To prepare a series of standards by which to judge other cottons, particularly new cottons produced by cotton breeders; (ii.) to determine the extent to which these standard cottons are affected by seasonal variations; and (iii.) to assist in the marketing of these cottons by providing the cotton trade with detailed information concerning them.

483. TECHNOLOGICAL REPORT ON SAMPLES OF PUNJAB-AMERICAN AND MOLLISONI (DESI) COTTONS GROWN IN DIFFERENT PARTS OF THE PUNJAB IN THE SEASON 1928-29. By A. J. Turner. (*Tech. Bull.*, Ser. A., No. 13, 1929.) Gives the grader's report, the fibre particulars, the spinning master's reports, the spinning tests results, and a general discussion of all the results obtained.

484. INDIAN COTTON: EXPORT AND SPINNING. By S. G. Warty. (*Ind. Text. J.*, **39**, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **9**, 1929, E. 16.) Deals largely with the work of the Indian Central Cotton Committee.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

485. The following reports have recently been received:

British Cotton Growing Association, Twenty-fourth Ann. Rpt., 1928.
BRITISH GUIANA: Admin. Rpt. of the Dpt. of Agr., 1928.
QUEENSLAND: Ann. Rpt. of Dpt. of Agr. and Stock, 1927-28.
SOUTH AFRICA: Official Year Book for 1927-28.

486. BRITISH COTTON GROWING ASSOCIATION. The Twenty-fourth Annual Report contains the usual interesting information. It is stated that with the continued depression in the cotton trade of this country the demand for cotton of outside growths during the year ended July 31 was less than for the previous season, the sales amounting to 642,690 bales. The total number of bales dealt with by the Association during 1928 was 124,182, of a value of £4,160,049. The approximate value of the Empire crop for 1928 is given at £9,386,000. Detailed accounts are included of the work of the Association in the various countries of the Empire. The Report is well furnished with illustrations, and contains the usual statistical appendices.

487. CYPRUS. *Cotton Prospects.* (Abstr. from the *Cyprus Agr. J.*, xxiv., **3**, 1929, p. 90.) The late and heavy rains have resulted in an increase of the acreage planted to cotton, and it is expected there will be an increase in production over that of last year.

488. IRAQ TO THE SUDAN. By Sir William Himbury. (*British Cotton Growing Association*, price 1s.) An account of a visit paid to Iraq and Palestine, and also to Egypt and the Sudan. It is stated that a wave of enthusiasm for the cultivation of cash crops, and especially cotton, is going through Iraq. Palestine does not at present offer much hope for cotton cultivation. Egypt was visited, and a trip made to the Gezira, where great changes have taken place in the last three years, 130,000 acres being now under Sakel, and the land well cultivated and clean. Sir William states that great credit is due to the Sudan Government and the Sudan Plantations Syndicate for their splendid organization of the Gezira. An account is also given of the research work that is being carried out.

489. British Malaya. *Cotton Cultivation.* (Abstr. from *Bull. of the Imp. Inst.*, xxvii., 2, 1929, p. 211.) The Economic Botanist reports that a good crop from selected types of cotton has been harvested, and examined as to purity, and the standard has been well maintained. The number of types under experiment has now been reduced to six.

490. Present Position of Cotton Cultivation in Africa. (*Int. Rev. of Agr.*, Rome, xx., 3, 1929, p. 104.) A general account of cotton-growing in Egypt, the British, French, and Italian colonies, with many references to the literature on the subject.

491. Kenya Colony. *Cotton Cultivation.* (Abstr. from the *Ann. Rpt. of the Dpt. of Agr.*, 1928.) During the year under review the culture of cotton showed little increase, although this crop is undoubtedly the best revenue crop natives can grow in the locations bordering on Uganda. Efforts were continued, with some success, to increase the acreage planted in Kavirondo and to improve cultural methods there. Prices paid for the 1927-28 crop were 20·17 cents per lb. for " A " quality, and 9 cents for " B " quality.

Prospects for the 1928-29 *Crop.*—Propaganda for the purpose of encouraging natives to increase the acreage planted began at the end of February. The standard of planting and subsequent cultivation showed considerable improvement, especially in the Samia location, which previously was one of the most backward areas. Weather conditions were generally favourable throughout the cotton area. One hundred and seventy tons of cotton seed were distributed for planting. Prospects were good at the time of writing, and an output exceeding that of last season was anticipated.

492. Cotton Growing in Nigeria. (Abstr. from *Man. Guard.*, June 26, 1929.) The export of cotton from Nigeria during 1928 was again disappointing, the total being 21,000 bales, but for the present year it is anticipated that a crop of 31,000 bales will be obtained.

493. Nigeria. *Cotton Experiments.* (Abstr. from *Bull. of the Imp. Inst.*, xxvii., 2, 1929, p. 213.) A report by Mr. O. B. Lean, Entomologist, of experiments in progress in 1928 to compare the ordinary Munshi cotton with the improved Ishan A cotton from Ibadan. Munshi cotton is normally grown in the locality through yams, though occasionally it is grown alone. It is a cotton very similar to the Ishan and Kabba varieties with a naked seed.

The general growth of the plants was greatly inhibited by the short dry season. Bacterial disease was common, though never very serious. Leaf curl was almost absent, but leaf roll was common, and counts showed this to be more prevalent on the Ishan than on the Munshi cotton. Stainers were almost entirely absent from the cotton grown through yams, though they were common on cotton grown alone where there was Allen cotton in the vicinity. Cotton through yams, however, suffered considerably from the attacks of other Rhynchota. On December 1, 5 and 15, 106 bugs were collected on bolls for analytical purposes. Of these only 3 were stainers, while 97 were Pentatomidæ of three " shield " or " stinkbug " types.

Comparative figures are then given for stainer infestation, flower counts of cotton grown alone and also through yams, bud shedding and boll shedding, for both varieties. In summarizing the results, Mr. Lean points out that although no definite conclusions can be made at this stage of the enquiry, it appears that the Munshi cotton does not produce nearly as many bolls as the Ishan, but that nearly all the pests are less attracted to it than to the Ishan, which is about two weeks earlier than the Munshi.

494. *Cotton Experiments.* (Abstr. from *Bull. of the Imp. Inst.*, xxvii., **2**, 1929, p. 212.) The Senior Entomologist, Mr. F. D. Golding, reports that surveys of the factors affecting the development of cotton are in progress under his supervision in three localities—viz., Ilorin, Badeggi (Niger Province), and Ibadan. In each locality the local cotton is being tested against the improved Ishan strain A. The results up to December 29, 1928, are summarized below.

"At Ilorin 'Ishan A' was tested against 'Ilorin,' both varieties being intercropped with yams. About 47 per cent. of the Ishan flowers have been shed, and 27 per cent. of the Ilorin; the corresponding figures at this time last year were 72 per cent. and 41 per cent. Judging from the calculated number of green bolls on the plants, the yields of both varieties will be greater this year than last, and the Ishan yield will approximate more closely to that of Ilorin. Bacterial disease in its various manifestations has been serious this year, and is, up to the time of writing, the principal cause of boll-shedding. Cotton stainers have again been scarce, and bollworms markedly less numerous than in the 1927-28 season. The virus disease, leaf curl, which was so prevalent last year, is almost entirely absent. Jassids were numerous in November, but have not been responsible for much damage.

"At Badeggi 'Ishan A' was tested against 'Allen,' grown alone. Up to December 15 the Allen cotton had yielded 229 lb. of seed-cotton per acre, of which about 81 per cent. was clean; few bolls remained on the plants. The Ishan harvest had only just commenced at that time; but, as 65 per cent. of the flowers had been shed, it is unlikely that a good yield will be obtained from the first flowering cycle. Jassids and bacterial disease were prevalent on both varieties in November; stainers have been about eleven times as numerous on Allen as on Ishan.

"At Ibadan 'Ishan A' was tested against 'Meko,' both being intercropped with yams. Up to January 5 both varieties had yielded between 16 and 17 lb. per acre; 62 per cent. of the Ishan and 39 per cent. of the Meko crop were clean. Bacterial boll-rots and bollworms were responsible for more damage to Meko than to Ishan, but bug damage was greater on the Ishan. Leaf curl is rare this year. Jassids were numerous on Meko earlier in the season, but were rare on Ishan."

495. South Africa. *Official Year Book for* 1927-28. Cotton is dealt with on p. 455, and is regarded as permanently established. It is stated that the available lands for future development, where soil and climate are favourable, comprise, generally speaking, the whole of the Middle and Low Veld. These areas include large stretches of country in the western Transvaal north of the Magaliesberg Mountains, in the northern and eastern Transvaal, Swaziland, Zululand, northern and eastern Natal, and numerous river valleys in Natal, and the eastern Cape Province. Cotton is also very successfully grown under irrigation in Griqualand West and along the Orange River. For the benefit of the industry twenty-two ginneries have been established in the Union, and two in Swaziland.

496. *Cotton Prospects.* (Abstr. from *Crops and Markets*, vii., **8**, Dpt. of Agr. S. Afr., 1929.) In his condition report on the cotton crop as at April 30, 1929, the Senior Cotton Grader refers to the serious bollworm damage in the Mkuzi area, Zululand, and in the western and northern Transvaal. In the Zoutspanberg district the crop is a failure. In the Hluhluwe, Richmond, and Umkomaas Valley areas in the Natal Province, along the Orange River in the Cape Province, in the Bremersdorp area of Swaziland, and in the district of Barberton, Transvaal, good crops are expected.

497. Cotton in South Africa. (*Natal Merc.*, June 8, 1929.) The latest Government forecast of production for the Union and Swaziland this season is 9,615 statistical bales, as against 8,811 bales for the previous season. The forecast must still be considered as tentative as the crop is unusually late. A further spell of hot weather is required in the Low Veld.

498. COTTON PRODUCTION IN THE UNION AND SWAZILAND. (Abstr. from *Crops and Markets*, vii., 8, Dpt. of Agr. S. Afr., 1929.) *Future prospects*: Briefly the position is that the jassid difficulty is definitely being overcome, and the only remaining serious problem is the bollworm. A great deal of attention is being given to this matter, and it is hoped that relief will be forthcoming as the intricacies of the problem are being studied and understood.

Mr. Parnell, the Corporation's Cotton Breeder at Barberton, when asked to express his opinion as to the future prospects of the cotton industry in the light of the progress made during the present season, stated that it is impossible to foreshadow, with any degree of certainty, the expansion likely to take place in cotton production in the Union and Swaziland: there are too many factors involved. The results this season, however, so far as the Low Veld is concerned, have more than justified the optimism felt last year.

The chief interest centres in the behaviour of the new strain, U. 4, of which the multiplication areas total 1,600 acres. The season has been decidedly unfavourable in most areas as the rains were late and lacking in amount. In spite of this, the bulk of the U. 4 planted has done very well, and in many cases excellent crops will be obtained. Apart from its resistance to jassid, which is of vital importance in overcoming this old limiting factor, U. 4 possesses other very valuable characters which make it a most useful strain. Farmers who have grown it, or seen it growing, are thoroughly satisfied with it, and there is a large demand for seed for the coming season. It is too early to say how much seed will be available, but it is hoped that the amount will be somewhere near 200 tons, sufficient for 40,000 acres at a low seed-rate. Had this seed not been available, there is reason to believe that the area planted to cotton in the Low Veld in the coming season would have shown a serious decrease. In the circumstances, however, it is likely that a somewhat larger area will be planted, and, given a fair season, the production should be more than proportionately increased.

If U. 4 does as well in the coming season, over a very large area, as it has done up to date on smaller areas, there is certain to be a revival of interest in cotton-growing. A few years of fair seasons and reasonable freedom from bad bollworm attacks would lead to a large expansion in the area planted. It takes a very bad season indeed to reduce the yield from U. 4 below the minimum for a paying crop, and the prospects are fairly satisfactory on this score. Bollworm, however, is a factor that has to be taken into account, and the amount of damage likely to be caused by it cannot be predicted. For this reason a steady, rather than very rapid, expansion is to be expected.

499. COTTON PROGRESS AND PROSPECTS: THE ORANGE RIVER COTTON LANDS. (Abstr. from *Sun and Agr. J. of S. Afr.*, June, 1929, p. 549.) Mr. Ingram, Director and Manager of the Cotton and Tobacco Exporting Company, Limited, of Germiston, gives a further interview on the prospects of cotton from the lower reaches of the Orange River. [*Cf.* Abstract **211**, vol. v., p. 180, of this Review.] His original forecast is being borne out by the extension of cotton-growing in this neighbourhood, and the excellent quality of the cotton.

500. SOUTHERN RHODESIA. *Cotton.* (Abstr. from *Rhod. Agr. J.*, xxvi., 7, 1929, p. 719.) The area planted to cotton in 1928-29 was 2,528 acres, which was nearly double that of 1927-28. About one-third of the acreage was under the new jassid-resistant variety U. 4, evolved at the Barberton Experiment Station, while a further small acreage was devoted to another variety known as A. 12. Both varieties are reported to be doing well, especially the U. 4, which is being grown under the supervision of the cotton specialist appointed by the Empire Cotton Growing Corporation.

501. Sudan. *Cotton Cultivation.* (Abstr. from *Br. Emp. Products No. of Times Trade and Eng. Suppt.*, May 25, 1929, p. 45.) Undoubtedly the most significant developments of the year ended March, 1929, have been the successful extension of the Gezira or Blue Nile irrigation scheme of cotton-growing, and the completion of the new Makwar-Haiya Railway, which, joining the existing Khartoum-Port Sudan main line at Haiya, a hundred miles from the Red Sea harbour, gives a direct line from El Obeid, and from the Sennar Dam and Gezira area, to the sea. The last section, from Gedaref to Makwar, was opened on February 15. This line relieves the congestion of cotton traffic on the Nile and on the circuitous main-line route through Khartoum, and of the Kordofan gum traffic from El Obeid, and may be fed by the border camel-borne trade touching Singa. It also ensures that the Gash Delta cotton scheme, now taken over by the Government, will be commercially practicable. Further, it traverses some 20,000 square miles of hitherto inaccessible but fertile country in Eastern Sudan, suitable for the production of rain-grown cotton.

The success and prosperity of the Gezira irrigation scheme, undertaken by the Sudan Plantations Syndicate Limited in co-partnership with the Government and the Sudanese tenant cultivators, has resulted in the widening of the main canal now being proceeded with, in advance of the original programme. With the increase of the area under the scheme to 300,000 acres, the one-third under cotton (according to the rotation plans one-third being allotted to grain and one-third lying fallow) is increased from 105,578 to 131,351 acres. Ample labour, of the seasonal nature desirable, is assured by the continual flow to the district of Mecca pilgrims from the west and south-west who settle for a while to work to obtain funds for their long journey. The delicate problem of supervising voluntary labour has been solved by the Government's adoption of the sheikh system of administration and supervision, whereby the establishment of tribal villages has been encouraged.

Cotton now represents 70 per cent. of the Sudan's total exports. In addition to the Blue Nile irrigation crop, bumper crops of American cotton, rain-grown by native cultivation with Government guidance, are indicated at the time of writing.

502. *Cotton Ginneries.* (*Monthly Rpt. of Coml. Intell. Branch*, Cent. Econ. Board, Sudan, xxiii., **6**, 1929, p. 139.) The Maridi ginnery, in Mongalla Province, started operations in April, and has been running satisfactorily. It is reported that each of the three gins is capable of dealing with 4·1 kantars of seed cotton per hour. Shukoli ginnery ceased work on April 13, having ginned most of the 1927-28 and 1928-29 crops.

503. *A Visit to the Sudan.* By W. Roberts. (Abstr. from the *Agr. J. of India*, xxiv., Pt. 3, 1929, p. 159.) In an interesting account of a visit to the Sudan to study cotton-growing problems there, the author describes the work of the Sudan Plantations Syndicate, the Ginning and Pressing Factory at Port Sudan, the Irrigation Department, and the general features of cultivation in the Gezira.

504. Tanganyika. The latest report received from the Department of Agriculture states that in some districts cotton is suffering from the effects of the drought, but that in Bagamoyo, Kilosa, Kisaki, and some parts of Rufiji cotton is doing well.

505. Uganda. *Cotton Cultivation.* By G. W. Nye. (*Bull. Imp. Inst.*, **26**, 1928. Abstr. from *J. of Text. Inst.*, xx., **4**, 1929, A. 159.) A summary is given of experimental work on cotton carried out during the first six months of 1928. Pests and diseases were practically absent, with the exception of jassids. Two strains with low boll-shedding rates have been isolated. S.G. 29 is a very promising strain, and is being grown in bulk for limited distribution. Sowing date experiments showed the advantage of early sowing, due in this season to the very dry weather. The spacing experiments indicated the advantages of closer spacing in nearly every area in which they were conducted. A significant increase in germination was shown after treatment of the seed with sulphuric acid. Samples of seed-cotton received from cotton-producing areas were satisfactory, but gave indications of deterioration of the N.17 strain in some areas, owing to intercrossing and mixture of seed, which is very difficult to control. A report of the main crop of cotton grown on the Serere Plantation is given.

506. *Cotton Industry's Problems.* (Abstr. from *Uganda Herald*, xxxi., 875, 1929, p. 9.) Captain Owen Tweedy, of the *Financial Times*, who has been studying the problems presented by the cotton-growing industry in Uganda, states that the main cause of the trouble is excessive rapidity of development—a common failing in a new industry—which has precipitated a crisis which he regards as only very temporary. The Government has profited by the experience, and plans are now in hand to increase the yield in the proved cotton areas, and place the industry on a more stable economic basis. The excessive proportion of ginneries is noticed, with the effects thereby produced.

507. *Report of the Commission of Enquiry into the Cotton Industry*, 1929. (Printed by the Govt. Printer, Entebbe, Uganda; price shs. 3/50.) This Report has recently appeared. The Commission was composed of the following members: Sir William Morris Carter (Chairman), the Hon. A. D. Jones (Member of the Legislative Council), and Mr. P. W. Adshead (Chief Accountant, Public Works Department). The terms of reference were:

(*a*) To frame estimates of the reasonable cost of purchase of seed cotton (exclusive of price paid), of transport to ginneries, of ginning and baling such cotton, and of transporting it to the railway, indicating as closely as possible the items comprised in these costs and the separate amounts thereof.

(*b*) Having regard to such estimates and other necessary factors, including the ruling price of Uganda cotton in the world's markets and the current price obtainable for cotton seed, to lay down a formula for ascertaining from time to time whether a fair price is being paid to native cultivators in Uganda for seed cotton.

And to investigate into and report:

(i.) Whether in accordance with that formula the prices paid to native cultivators of cotton in Uganda during each of the years 1927, 1928, and 1929 were fair and reasonable.

(ii.) Whether, and to what extent, the formation of Cotton Buying Associations has had a prejudicial or beneficial effect on the price paid to native cultivators, and on the cotton industry generally.

(iii.) Whether, and in what manner, the Government could or should intervene in an endeavour to ensure that fair prices are received by native producers of cotton.

The Report commences with a brief history of the cotton industry in Uganda since its inception in 1903. Cotton was bought and collected mainly by Indian traders, who stored it in their shops. Open markets succeeded this system of trading, and these in turn were replaced by permanent centres, with permanent buildings, such as exist at the present day. A cotton tax of 4 cents per pound of lint, imposed in 1919, has now been placed on a sliding scale according to the price of American Middling, Liverpool. After the war the building of ginneries proceeded rapidly, and while in 1914 there were only 20, there were 176 working in 1926. Associations of ginners for buying purposes are now coming into operation.

The estimates called for in (*a*) of the terms of reference are given in considerable detail in Appendix 3, and a summary of the costs is also included. Costs vary in different parts of the protectorate, and separate figures are therefore given for Buganda, Eastern Province, and Northern Province; the Commission is of opinion, however, that the time available for an exhaustive examination of costs was far too short.

It is shown in the Appendix that the greatest differences in price occur in buying expenses, costs of labour, transport hauls, and railway freight.

In reference to Section (*b*) of the terms of reference, the Commission considers that it is both possible and practical to lay down a formula of cost to ascertain from time to time whether a fair price is being paid to the native cultivator in Uganda for seed cotton. The formula recommended is as follows:

$$X \left\{ \begin{array}{l} \text{the price payable to grower in cents per} \\ \quad \text{lb. of seed cotton} \end{array} \right\} = \tfrac{3}{10}\,(A+P-C);$$

where A is the price of American futures four months ahead to allow time for the cotton to arrive on the Liverpool market; P an approximate figure to represent the probable premium payable for Uganda cotton on that date; C a figure to represent the cost of buying, transport, ginning, etc., and overhead expenses (as represented in the Table of Costs). 30 per cent. of the figure thus arrived at would then represent a fair price payable to the native cultivator per pound of seed cotton. The Commission explained that the assessment of the probable premium payable for any grade of Uganda cotton over American Middling four months in advance presents a great difficulty, and could only be given by experts actively engaged in the Liverpool cotton market. It considers, however, that the Government could make satisfactory arrangements to receive periodical advices in this respect from members of the Liverpool Cotton Association.

The adjustment of costs for each area mentioned in the Table of Costs is then dealt with under the heads of profit, savings effected by co-operative buying, increase or decrease of output, and cotton seed.

In regard to Section (i.) of the terms of reference, the actual prices paid to growers as compared with those deduced from the formula are given for the last three years, and the opinion is expressed that the prices paid during this period were generally fair and reasonable, with the possible exception in 1927 of those paid in the Bukedi, Teso and Lango areas, and in 1928 in Buganda and the Bukedi area.

In regard to Section (ii.) the Commission considers that the formation of Cotton Buying Associations has not greatly affected prices except in Buganda, but it has affected the prices received by individual growers, and has thus bewildered the natives. The formation of these associations has, however, undoubtedly reduced the buying costs and curtailed the operations of middlemen.

In considering the present condition of the cotton industry, the Commission points out that Uganda is over-ginneried, and that 50 per cent. of the present ginneries would suffice. It is stated that the ginners must combine for self-preservation, that the number of ginneries should be reduced, and that the capacity of those remaining should be enlarged in order to deal with the greater output, and that groups of ginneries, each under one management to save managerial and overhead expenses, should come into being.

In view of the above circumstances, the Commission recommends, in regard to Section (iii.) of the terms of reference, that the Government, while not taking any drastic steps at the moment, should define its attitude and indicate its future lines of action. It is also recommended that legislation should prohibit increase in the present ginning capacity except as approved by Government, a Board being appointed to deal with the question, and that Government be authorized to act in the best interests of the natives if no association has been formed among the ginners by September 1, 1931.

Associations in certain respects should be controlled by Government, and when four-fifths of the ginners in the Eastern and Western area have joined, the remainder should be compelled to come in or lose their licences. The terms of Government control are considered, and recommendations made for the prevention of cheating and sharp practices.

In discussing the question of improvement in and increase of cotton cultivation in Uganda, the Commission recommends the appointment of additional officers to the staff, more demonstrations of modern methods of cultivation by the use of implements, etc., given to the natives; instruction in schools; more attention paid to rotation of crops and information on all cotton matters given to native chiefs, and efforts made to bring about closer and more cordial relations between grower and ginner, in order that they may realize their dependence on one another.

The report contains several long appendices dealing with costs, assessment of compensation, and miscellaneous matters.

[*Cf.* following abstract.]

508. COTTON POLICY IN UGANDA. A memorandum has been gazetted by the Uganda Government regarding its attitude towards the findings and recommendations of the Cotton Enquiry Commission, premising that "it is recognized that the problem of surplus capacity is at the root of all the difficulties which the ginning industry in Uganda has to face at the present time." The Government subscribes to the doctrine that there should be drastic reduction in the number of units by amalgamation, the deliberate elimination of the least efficient, and the concentration of production on the units with the least cost of production.

The difficulty of forming such a Board as that recommended for the purpose of deciding which ginneries are redundant is well known, but His Excellency the Governor is prepared to discuss the formation and constitution of such a Board with the leading members of the ginning industry. The questions of legislative and financial assistance to the industry and of making large increases in the Agricultural staff are ones which cannot be decided without further deliberation.

The memorandum concludes with a cautionary clause as follows: "It must be made clear that while some of the recommendations which will be made to the Secretary of State for the Colonies with regard to the Commission's report can now be indicated, the final decision does not rest with the Government of Uganda, and while the latter recognizes the urgency of many of the Commission's proposals, there can be no question of implementing them until the attitude of the Secretary of State is known."

509. QUEENSLAND COTTON INDUSTRY. (Abstr. from *Ann. Rpt. of Dpt. of Agr. and Stock*, 1927-28, recently received.) From this report we quote the following: "A very limited local demand for Queensland cotton marked the season under review. The situation was saved by outside market values, and, on present appearances, Queensland cotton will obtain prices in Liverpool that, coupled with the Commonwealth bounty, will give returns sufficiently high to make cotton-growing profitable where average yields have been gathered."

"A committee, representative of all parties concerned in cotton-growing and manufacture in Australia, has placed a comprehensive scheme for the development of both the production and spinning sides of the industry before the Federal authorities. If the provisions of this committee's report are made effective, a keen demand for Queensland cotton will develop, and at prices likely to be profitable to the grower."

It is stated in the Report that the quality of the cotton was lower during the year under review than in previous seasons owing to the very heavy rainfall experienced at the time of picking. Injury from pests and diseases, though severe in some districts, was not generally very serious. At the Callide Research Station varietal trials, thinning and spacing tests, fertilizer experiments, soil studies, and studies on insect problems, were continued.

510. THE COTTON CROP IN QUEENSLAND: HAND PICKING. (*Daily Mail*, Queensland, April 12, 1929.) A description of the way in which cotton is picked, pointing out that the cost of picking is the most serious item in the budget of a Queensland cotton-grower. It is stated that the best method of picking cotton is to use a bag from 6 to 8 feet long and about 2 feet wide. This is slung over one shoulder by means of a strap, the mouth of the bag coming level with the hips. The greater part of the bag is on the ground, and it is dragged by the picker behind him. The advantage of this is that there is no weight on the body, and the movement of the arms is not hampered. Such a picking-bag can easily be made at small cost by sewing two corn sacks end to end and cutting the bottom out of one. The bag will easily hold 30 lb. to 40 lb. of cotton, and need only be emptied two or three times a day.

511. *The Cotton Industry and the Tariff.* (Abstr. from *Queens. Agr. J.*, xxxi., **4**, 1929, p. 303.) A statement by the Minister for Agriculture dealing with the question under the following heads: Tariff Anomalies; Cotton-Growing needs Protection; Detrimental Delay; Serious Risk to the Industry; No Tangible Security for the Cotton-Grower under Existing Tariff.

512. *Federal Bounties: The Case for Cotton.* (Abstr. from *Queens. Agr. J.*, xxxi., **4**, 1929, p. 321.) Mr. F. M. Forde, in defending the cotton industry, recently pointed out that, out of a total amount of £895,498 spent on bounties by the Commonwealth Government for the financial year 1927-28, the bounty paid on seed cotton only amounted to £81,453, and on cotton yarn to £24,846.

513. FIJI. *Cotton Cultivation.* (Abstr. from *Bull. of the Imp. Inst.*, xxvii., **2**, 1929, p. 211.) The Superintendent of Agriculture reports that during the half-year ended December 31, 1928, further single-plant selections were made from a single-seeded type of hardy Kidney cotton, obtained originally by Colonel Evans from New Guinea. More than 600 acres of one of the selections have been planted in an isolated district, and the results are being awaited with considerable interest.

514. WEST INDIES. *Cotton in Barbados.* (Abstr. from *West India Comm. Circ.*, xliv., **804**, 1929, p. 293.) Re-establishment of the cotton industry in Barbados is receiving the serious attention of the Department of Agriculture, and it is believed that with careful observance of the close season, and a thorough cleaning up of cotton fields, the industry can again be established and a remunerative subsidiary crop set up.

515. WEST INDIES. *Montserrat's Trade in* 1928. (Abstr. from *Trop. Agr.*, vi., **7**, 1929, p. 199.) The year under review proved a most successful one from an agricultural point of view. Cotton was again the Island's mainstay, 666,000 lb. of lint being shipped. This represents the satisfactory yield of 222 lb. of lint per acre.

516. WEST INDIES. *Cotton in Montserrat.* (Abstr. from *Bull. of the Imp. Inst.*, xxvii., **2**, 1929, p. 211.) The Curator reports that during the year 1928 the breeding plots were increased, and harvesting operations therefore proved a much larger undertaking than in previous years. Some 1,500 individual selected trees were under investigation for the various counts, such as loculi value, seed-cotton per boll, lint per boll, bolls per lb. of seed-cotton, lint length, lint index, seed weight, shedding, etc. In order to purify to a very high degree and maintain the uniformity of the Montserrat cotton staple, all flowers appearing in the main breeding plot were self-fertilized. This, although a difficult and expensive task, will supply a better scheme for the reliable perpetuation of the very desirable characters of the Heaton strains.

Pink bollworm investigation work was continued for the fourth year, and very valuable information has been obtained with the view of securing a second crop of cotton. It has been shown that by early planting it is now possible in Montserrat to obtain not only a first crop but some second crop. This early method of planting, however, is not the only means of controlling pink bollworm. Control has also been achieved by the effective cleaning up of old cotton fields and the breeding of a type of cotton which is a very early bearer. By these combined factors Montserrat obtained in some places another 20 per cent. second-crop return as well as a full first crop during the year under review; the disastrous storm of September, however, cut off the second-crop prospects prematurely.

517. West Indies. *Cotton in St. Vincent.* A report recently received states that the yield for the 1928-29 Sea Island cotton crop amounted to 263,908 lb., giving a return of some 78 lb. of lint per acre. This poor yield was due to soft rot of bolls (Phytophthora), caused by heavy rains during the bolling season. An attempt is being made to prevent this in the future, and no cotton will be planted during the coming season until September 1, which will ensure that a large proportion of cotton bolls will ripen in the drier months of the year. All cotton plants were destroyed by April 27.

518. West Indies. *Cotton Planting Season in St. Vincent.* We have received from Professor Ballou a copy of a report on his recent visit to St. Vincent to bring about a discussion of the best time for planting cotton in that island. The yield of Sea Island in St. Vincent has been low for several years past, the most regular cause being the excessive moisture in October and November, which has aggravated the loss due to soft rot and excessive boll-shedding. A meeting of cotton-growers was called to discuss the matter with Professor Ballou, and as a result it was decided that the first day of planting this year should be September 1, instead of in June, as has hitherto been the practice. The planting date could be altered to October in another year, if this month were found to be more suitable.

COTTON IN EGYPT.

519. Cotton Prospects. (*Int. Rev. of Agr.*, Rome, July, 1929.) Favourable weather in June helped the development of the crop. Damage from pests appeared to be less than last year.

520. The Operation of the Seed Control Law upon the Pedigree of Cotton Seed in Seasons 1926-27 and 1927-28. By W. L. Balls and A. Eff. Bedevian. (*Tech. and Sci. Serv. Bull. No.* 85, Bot. Section, Min. of Agr., Egypt, 1929.) Among interesting statements in this paper we may quote the following: "One of the most notable of the facts which long experience impresses on students of cotton is this: that it is utterly impossible to prevent contamination of the seed of any variety when it is being grown in bulk. The agents which bring in actual seed from other varieties comprise such varied things as birds, mice, and irrigation water; there is always the risk of resowing with foreign seed; there is some mixture in the ginnery, however carefully it is cleaned; lastly, there is natural crossing by the transport of pollen, which has recently been shown to produce about ¼ per cent. of rogues at a distance of a hundred metres from the contaminating foreign stock; and it should be noted that ¼ per cent. is equivalent to 60 such rogues in a feddan, since this area usually contains 24,000 plants.

"There seems to be good reason to believe that even if a variety of cotton is never grown in blocks of crop smaller than 100 feddans, if every care is taken in sowing and resowing, and if the ginneries, sacks, etc., are cleaned with meticulous care, then the rogue plants which appear in the following year (having crept into the hundred feddans from outside by the various causes just specified) will number somewhere about 300 per feddan. Such rogues if not recognisable before they flower (and most inter-Egyptian crosses are not recognizable even then) cannot be eradicated completely by a 'roguing' selection. They are henceforth a permanent constituent of the variety, continually reinforced each year, and they spread through it by progressive infestation till the original variety no longer is recognizable; it is said to have 'run out.' Such a contaminated variety can, however, be resurrected if a small stock has been preserved from such contamination by those precautions which are familiar in the genetics laboratory, because this stock can be multiplied rapidly with only slight contamination to replace the damaged goods."

The paper gives a detailed account of the operation of the law and its results, which seem excellent on the whole.

521. Government Financial Aid to Small Farmers. (Abstr. from *Int. Cot. Bull.*, vii., **28**, 1929, p. 641.) With a view to helping the small farmers, the Government decided early in June to constitute an "Agricultural Reserve" consisting of:

(*a*) A sum of £4,000,000 to be used for loans.
(*b*) The proceeds of the Government cotton stocks, which are to be sold.
(*c*) The annual income from the cotton tax.

Sums will be advanced to the farmers at the commencement of the season against cotton received.

522. A Preliminary Note on some New Strains of Uppers. By C. H. Brown. (Abstr. from *Int. Cot. Bull.*, vii., **28**, 1929, p. 621.) Deals with the performance in Upper Egypt of Giza 2, Giza 3, and Giza 7, three new strains of cotton which originated by single-plant selections made from the ordinary Ashmouni and Zagora crops. Yield, ginning out-turn, lint quality, graders' opinion, spinning reports, results obtained at the Fine Cotton Spinners' Association Research Station, and tests by commercial mills are discussed.

523. Egyptian Cotton: Halo Length and Effect of Locality. By C. H. Brown. (*Tech. and Sci. Serv. Bull. No.* 84 [Bot. Sec.] Min. of Agr., Egypt, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **14**, 1929, E. 21.) Frequency distribution curves of halo lengths of Egyptian cottons in each of five localities in Upper Egypt, and six localities in Lower Egypt, together with the average graph for each group, are reproduced. The all-localities curves for Upper Egypt indicate that Giza 2, now known as Ashmuni Gedeed (New Ashmuni), is the purest type, closely followed by Zagora B. Ashmuni C and Giza 3 both show evidence of impurity. In Lower Egypt, Garofalou appears to be the purest type, but there is a distinct difference between the purity of all the Botanical Section's types and Sakel Domains, which is both less condensed in the body of the curve, and has a very pronounced "tail" of short halos. Similarly, the broad effects of locality are seen in the all-strains curves. In Upper Egypt, Mansafis, Fashn (El Gafadon), and Giza have given almost identical lengths. Maragha is distinctly shorter—an effect which must probably be attributed to the hotter climate —and Senaro slightly so, but here the chequer plot was particularly badly cultivated, and this may have affected the halo lengths. The paper continues with a more detailed analysis of the effect of locality on halo length.

524. Maarad Cotton. By R. Sennitt. (*Int. Cot. Bull.*, vii., **28**, 1929, p. 630.) [*Cf.* also article, vol. vi., p. 27, of this Review.]

525. Égypt. *Use of the Waters of the River Nile for Irrigation Purposes.* (Treaty Series No. 17, 1929. Cmd. 3348.) The Report of the Commission appointed by the Governments of Great Britain and Egypt for the purpose of examining and proposing the basis on which irrigation can be carried out with full consideration of the interests of Egypt, and without detriment to her natural and historic rights.

COTTON IN THE UNITED STATES.

526. RETROSPECT OF THE 1928 U.S.A. COTTON CROP. By N. S. Pearse. (Abstr. from *Int. Cot. Bull.*, vii., **26**, 1929, p. 293.) *Neppiness in Cotton.*—The author noticed on the sample tables at Memphis, at the beginning of the season, the very neppy condition of the cotton. The cause of this was due to the ginning of the cotton while " green " or moist; the moist cotton clogs on the saws of the gin, and creates the well-known and much-disliked " nep." Eventually these " neps " work off the teeth of the saws into the ginned cotton. It is usual to have a little neppy cotton at the commencement of the picking season, but larger quantities came forward in 1928 because the cotton was ginned as soon as picked. This was necessitated by the fact that so many seed-cotton storage huts on plantations were destroyed by the floods, and have not yet been rebuilt. This quick ginning of the cotton not only makes for neppy cotton, but the lint has no opportunity to absorb any oil from the seed while waiting to be ginned—thus failing to obtain the specially prized rich and glossy feel and creamy appearance. It is well known to Memphis cotton buyers that seed cotton stored a week or ten days gives a better grade and a stronger lint than cotton ginned the same day as picked.

527. PROPOSED TARIFF ON EGYPTIAN COTTON IMPORTS INTO U.S.A. (Abstr. from *Int. Cot. Bull.*, vii., **28**, 1929, p. 637.) Mr. C. T. Revere, partner in Munds and Winslow, one of the largest futures houses of New York, in protesting against the suggestion to place a high import duty on foreign cotton, particularly Egyptian cotton, makes the following remarks: " Some of our soundest economic thinkers take the view that a high tariff for this country is now an anachronism with little justification for its existence. We have an industrial capacity more than sufficient for domestic needs, and we are seeking export outlets. The foreigner cannot buy except through payment by gold shipments, services, exchange of goods, or sale of securities. Gold is not available in bulk, and services represent a small item. If we build up a high tariff wall, preventing or reducing the entry of goods from abroad, we are faced with the necessity of lending to foreign buyers in order that they may take our raw materials and surplus industrial output. This process cannot go on for ever. It would be an absurdity to place a tariff on 200,000 bales or more of Egyptian cotton when we consider the questionable benefit to American growers, and the great loss entailed in buying power from abroad."

[*Cf.* Abstract **329**, p. 264 of this Review.]

528. COTTON IN CALIFORNIA AND THE SOUTHWEST. (Abstr. from *Southern California Crops*, vol. v., No. 7, 1929.) Advantages of cotton production on good lands under irrigation in California and the Southwest are: the freedom from major cotton pests and rigid quarantine measures for the exclusion of these pests, high acre yields—and subsequent lower costs of production,—acceptance of the one-variety community idea, and the possibility under good management of producing premium cotton. Acala cotton is the variety chiefly grown, and is the only variety in many districts. This " one variety to one district " system has prevented a good deal of deterioration.

Cotton lands vary in price from $125 to $350 per acre, with water. They may be leased at a reasonable figure, or secured on a crop share basis.

A survey in Kern County shows the following figures for average cost per acre:

Labour	50.40
Materials	8.35
Cash overhead	4.51
Interest and depreciation (improvement and equipment)	6.52
Interest on investment in land (at 6 per cent.)	14.62
Total	$84.40

The average yield is 542 lb. of lint, which gives an average cost of 15·5 cents per lb., and 9·3 cents profits.

529. FACTS AND PROBLEMS OF FARM CREDIT IN CRAIGHEAD COUNTY, ARKANSAS. By A. N. Moore and C. O. Brannen. (*Bull. No.* 233, Univ. of Ark. Agr. Exp. Sta., 1929.)

530. FARM ORGANIZATION AND MANAGEMENT IN TYPICAL UPLAND SECTIONS OF ARKANSAS. By J. A. Dickey. (*Bull. No.* 235, Univ. of Ark. Agr. Exp. Sta., 1929.) The large farm proved to be more efficient than the small, and showed a uniform increase of labour income with size. The small farm, like the small business, showed a high percentage of unproductive labour, and was nearer to the point of diminishing returns.

Work on cotton represents over 50 per cent. of the productive labour, and the amount of cotton per man increased 2 per cent., with a 10 per cent. increase in the size of the farm.

531. CREDIT PROBLEMS OF GEORGIA COTTON FARMERS. By A. N. Moore *et al.* (*Bull. No.* 153, 1929, Exp. Sta. Ga.) Proceeding from an analysis of the cost of short-term credit, the basic principles of sound credit practice are set forth, and illustrated by the case of fertilizer loans. Two other problems of judgment in the use of credit are then taken up—that of financing diversification programmes, and that of financing the holding of cotton for higher prices. There is also a brief discussion of the special difficulties of the men whose farms are mortgaged. In conclusion, some possible means are suggested for overcoming the obstacles to the safe and profitable use of credit.

532. ATTITUDE OF OKLAHOMA FARMERS TOWARDS THE OKLAHOMA COTTON GROWERS' ASSOCIATION. By W. W. Fetrow. (*Exp. Sta. Bull. No.* 178, Oklahoma, A. and M. Coll. Agr. Exp. Sta.) An interesting statistical study, showing some of the difficulties that arise—inexperience of the farmers in co-operative methods, excessive promises by leaders of the movement, lack of understanding of the contract and of confidence in the management, etc.

533. AMERICAN TEXTILE NOTES. By W. Whittam. (Abstr. from *Text. Rec.*, xlvii., **555**, 1929, p. 82.) It is being advocated in the South as a measure to discourage the growth of short staple cotton that the price penalty on all staples below ⅞ inch be increased. There is, indeed, increasing alarm over the steadily deteriorating staple length and quality of American Upland varieties. The writer points out that much of the farmer's indifference in this connection arises from the fact that he is all too often cheated out of a good part of the premium to which he is rightfully entitled for longer staples by unscrupulous local buyers.

There is also an increasing volume of complaint about the quantities of unripe and wet cotton brought to the gins. Gin operators are being advised to refuse to handle stock in this condition as a coercive measure.

534. COTTON MILL: COST OF ERECTION IN U.S.A. (*Text. World*, **79**, 1929. Abstr. from *J. of Text. Inst.*, xx., **6**, 1929, A. 347.) It would cost approximately 2,250,000 dollars to erect a 50,000 spindle cotton mill complete with land, buildings, machinery, and supplies. If the mill were erected in the South, it would be necessary to erect a mill village, which would cost approximately 400,000 dollars. These figures are for a complete unit of new machinery. It would cost about the same per spindle whether the mill were planned for yarns averaging 15s. or 30s.

535. SPINNING: TEXTILE OPERATING EXECUTIVES OF GEORGIA. (*Cotton*, U.S., **93**, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **9**, 1929, G. 15.) Records are submitted by ten mills in the U.S.A. of end breakages per thousand spindles per hour, with causes. The particulars given are counts, single or double roving, sizes of ring and traveller, roller and spindle speeds, drafts and twists; and causes of the stops are classified into thirty types.

536. REVISION OF STANDARDS FOR AMERICAN-EGYPTIAN COTTON. By W. Whittam. (Abstr. from *Text. Rec.*, xlvii., **555**, 1929, p. 82.) An order promulgating revised standards for American-Egyptian cotton and for Upland cotton of extra white colour has been issued by the Secretary of Agriculture, United States. A need for the new standards for American-Egyptian cotton was found to exist, since changes in the colour and preparation of the American-Egyptian crop during recent years have been such that the present standards were no longer representative of American-Egyptian cotton as now produced, according to the Bureau of Agricultural Economics which administers the Cotton Standards Act.

The new standards, both American-Egyptian and extra white, will become officially effective August 1, 1930, but under the terms of the order of promulgation they may be used meanwhile permissively in the purchase and sale of spot cottons of these descriptions, when specific reference is made to them in descriptions mutually agreed to by buyers and sellers.

COTTON IN FOREIGN COUNTRIES.

537. LA CULTURE DU COTONNIER EN ARGENTINE. (Abstr. from *Coton et Cult. Coton.*, iv., **1**, 1929, p. 85.) Gives much information regarding cotton cultivation in the Republic, with figures showing the area planted, production of raw cotton, production and export of cotton lint and cotton seed over several seasons.

538. COTTON GOODS IN ARGENTINA: IMPORTS. By C. D. Thurston. (*Text. World*, **75**, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **9**, 1929, I. 26.) Details are given of the popular styles of cotton goods imported by Argentina, and particularly of those not supplied in quantity by the United States. American manufacturers either never were in favour, or have recently gone out of favour in several lines. Questions of cloth widths and weights seem to be the deciding factors in many cases.

539. COTTON AND THE BELGIAN COTTON INDUSTRY. By B. P. Pfliegor. (Abstr. from *Int. Cot. Bull.*, vii., **28**, 1929, p. 689.) The Belgian mills are employing more and more Indian cotton as against American, and this is attributed not only to its greater cheapness, but also to its suitability to the Flemish worker, who is not skilled in the production of fine counts. Certain types of Indian cottons have been found suitable, either pure or in mixture, for the production of articles formerly made solely of American. The two cottons show themselves, in the Belgian import tables, to be interchangeable to a very considerable degree.

540. COTTON FACTORY IN BOLIVIA. (Abstr. from *Int. Cot. Bull.* vii., **28**, 1929, p. 665.) A factory containing 200 looms for making grey sheetings, drills, ginghams, and trouserings is being completed. The new industry is to be assisted by the Government by free importation of raw material for four years, or until such time as raw materials should be available in the Republic, by the increase of import duties on the articles of the kind imported from abroad, and certain other advantages to be enjoyed by the concessionaires.

541. Brazil. *Brakes on Industrial Progress.* By Dr. P. Nogueira. (Abstr. from Brazilian Special Number of *Man. Guar. Coml.*, June 27, 1929.) Seventeen of the States of Brazil, with 349 mills, are engaged in cotton spinning and weaving, the annual production being 713,386,977 metres of cloth, and 1,981,273 kilos of made-up goods. There are 78,234 looms and 2,580,150 spindles, and 128,603 male and female operatives are employed. The mills consume Brazilian cotton, the foreign staple being unable to compete owing to the high Customs duties. The majority of the mills produce only the coarser qualities of textiles.

542. *Improving the Standard of Cotton.* (Abstr. from Brazilian Special Number of *Man. Guar. Coml.*, June 27, 1929.) The work of the Federal Cotton Service is described. At present there are twenty-eight experimental stations, and twenty-five seed farms in operation. A brief account is given of the aims of the stations and of the methods of study and selection. Arrangements for the supply of seed and insecticides, and for baling and classification of cotton, are discussed. Laboratories for technological investigations have been established, and a statistical service has been organized. A table is included showing the production of cotton during the last seven years.

543. Statistical Information Concerning Cotton Spinning in China. Cotton Yarn Association, Ltd. (Abstr. from *J. of Text. Inst.*, xx., **6**, 1929, T. 101.) The statistics relating to cotton spinning in China complete the survey of the industry in the Far East. The available data are much less complete than those in relation to India and Japan [*Cf.* Abstracts **146** and **345** of this Review], but the main principles and the effect upon the spinners' position in this country are none the less clear.

544. Cotton Testing, Shanghai. (Abstr. from *Text. Rec.*, xlvii., **556**, 1929, p. 85.) New regulations have been promulgated by the Shanghai Bureau of Inspection and Testing of Commercial Commodities, Ministry of Industry, Commerce and Labour, to govern testing of cotton for export from the port of Shanghai. One of the articles states that the standard for moisture content shall be set at 12 per cent., and the maximum moisture content allowable for certification at 15 per cent. Cotton containing more than 15 per cent. moisture or adulterated with other foreign matters shall not be certified or allowed to pass through the Customs.

545. Association Cotonnière Coloniale. We have received a copy of *Bull. No.* 87, 1929, containing, among others, the following articles: Extrait du Rapport sur l'industrie cotonnière, " by M. A. de la Baumelle; " La culture du coton dans l'état de Syrie en 1928"; " Le coton au Soudan Français"; " Un essai de culture du coton à Madagascar"; " La culture du cotonnier en Nouvelle-Calédonie."

546. Etude Technologique de Cotons du Cameroun et d'un Coton de la Haute-Volta. (Abstr. from *Coton et Cult. Coton.*, iv., **1**, 1929, pp. 55 and 62.) Details of yield, lint index, weight of seed, characteristics of fibre, classing, etc., are given for the varieties Kirdi and Foulbé, and also of an unnamed variety from Haute-Volta.

547. Mission d'Inspection et d'Etudes en Afrique Occidentale Française de M. Hesling. We have received from the Association Cotonnière Coloniale a copy of a report on the tour made by M. Hesling, the Director of the Association. On p. 272 of the report an interesting account is given of a visit paid to Nigeria for the study of cotton cultivation there, carried on as it is under conditions very similar to those in the French West African colonies. The Empire Cotton Growing Corporation's Seed Farm at Daudawa was among the places visited.

548. CONDITIONS DE DEVELOPPEMENT DE LA CULTURE COTONNIÈRE DANS L'OUEST AFRICAIN ET PARTICULIÈREMENT AU SOUDAIN FRANÇAIS. By J. Vuillet. (Abstr. from *Coton et Cult. Coton.*, iii., **3**, 1928, p. 211.) The quality of the cotton grown in French West Africa and French Sudan is stated to be very poor, and the author discusses the methods that must be adopted to improve the quality, and some attempts that have already been made in this direction.

549. CONTRIBUTION A L'ETUDE DU COTONNIER AU MAROC. By E. Miege. (Abstr. from *Rev. de Bot. App. d'Agr. Tropicale Bull. No.* 91, 1929, p. 169.) The future success of cotton in North Africa and in Morocco depends on the cultivation of early maturing varieties. Some selected forms of Pima have provod the most suitable types.

550. COTTON PRODUCTION AMONG THE NEGROES. By G. Monteil. (*Etat Actuel de Nos Connaissances sur l'Afrique Occidentale Française. IV. Le Coton chez les Noirs. Paris : Com. Etudes Hist. et Sci. Afr. Occident. Franç.*, 1927. Abstr. from *Exp. Sta. Rec.*, lx., **6**, 1929, p. 534.) An account of the development of cotton-growing, and the utilization of the crop by the natives of French West Africa. Information is given on producing districts, varieties, cultural practices, and the preparation of cotton fabrics.

551. LE MARCHÉ COTONNIER DU HAVRE. By H. du Pasquier. (*Coton et Cult. Coton.*, iv., **1**, 1929, p. 1.)

552. ITALIAN COTTON TRADE. (Abstr. from *Text. Rec.*, xlvii., **556**, 1929, p. 85.) The Italian cotton industry gives occupation to from 240,000 to 260,000 operatives, and is equipped with approximately 5,300,000 spindles, 850,000 twisting spindles, 150,000 power looms, 20,000 to 25,000 hand looms, and 160 printing machines.

553. SPINNING AND WEAVING IN JAPAN. (*Cotton* M/c. 35, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **10**, 1929, G. 17.) The consumption of raw cotton, the monthly average of active cotton spindles, and the production of yarn and cloth as reported by the mills belonging to the Japan Cotton Spinners' Association, are given for the years 1905 to 1928.

554. SPINNING: COSTS OF PRODUCTION IN JAPAN. By F. Utley. (*Man. Guar. Coml.*, 1929, **18**, 489-90). The author compares Japanese and British costs as given by employers on both sides.

555. WEAVING COSTS IN JAPAN. By F. Utley. (*Man. Guar. Coml.*, **18**, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **9**, 1929, M. 9.) The costs of production of plain woven cloths made as subwork by spinners, and of twills and coarse sheetings made in separate weaving sheds of 100 looms or more in Japan, are analyzed and compared with the costs in Lancashire. Weavers work longer hours in Japan than in England, and Japanese weavers can attend to at least as many looms as English weavers, and do attend to more when they have had a couple of years' experience, or when engaged on coarse goods. For working as many as six looms a Japanese weaver only earns about 2s. 9d. a day for 11 hours' work, whereas an English weaver on four looms would be earning about 6s. 8d. a day for a 48-hour week. Calculations of weaving costs and total labour costs from information supplied by Japanese manufacturers show that these are only about one-third of the British costs.

556. SPINNING AND WEAVING COSTS IN JAPAN. By T. Ryan. (*Man. Guar. Coml.*, **18**, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **9**, 1929, M. 9.) The discrepancy between the costs given by Miss Utley (above), and the statistical data contained in the Cotton Yarn Association's publication and the Cunningham report are discussed. It is pointed out that the former are based on observations

in only a few mills, and that there is no proof that the results are an average for the trade. Comparisons were made for 20s counts, and it must be remembered that these are the principal counts spun in Japan, and that the mills have to be organized so as to get the maximum production on this count, whereas in Lancashire the range of counts spun in any one mill is usually very much larger. When comparing labour costs it is very difficult to make sure that the same items have been included in each. If the weaving figures given by Miss Utley are worked out on the same basis as those of the Cotton Yarn Association, they show 2·3 looms per weaver, and therefore agree with the Association figures.

557. JAPAN AND CHINA. By A. S. Pearse. (*Int. Cot. Bull.*, vii., **28**, 1929, p. 557.) From the conclusions arrived at by Mr. Arno Pearse on his recent journey to Japan and China we quote the following: "The Japanese cotton-spinning and manufacturing industry could never have achieved its present position without that group instinct which is generated by the family system, and which is still characteristic of Japan. The individual is only a small entity, he will put his firm first, and the firm puts itself in the background, but works for the national welfare. The Emperor is still the personification of Deity, and every Japanese claims to be part and parcel of his family; the whole State is one 'trust.' It is that spirit which has been the cause of Japan's rapid development, and it is the same group instinct that has led to the huge combinations in the Japanese cotton industry.

"I would attribute as a second cause for Japan's rapid advancement what we in Europe would call speculation, and the third cause is to be found in the organization. There are four mill combines controlling 60 per cent. of the whole industry. Then there are three very large cotton-buying firms, which also undertake the selling of the manufactured goods, and have cut out any intermediary between themselves and the wholesale dealer in China, India, etc. These cotton importers have houses in many parts of China, India, Java, etc., and handle the manufactured goods at a very low profit.

"As the last advantage, there is the cheaper cost of labour in spinning as well as in weaving. From information which I have been able to gather, the labour cost for spinning 20s is about ½d. per pound cheaper than that of the cheapest countries in Europe. As regards labour cost of weaving, the fact that the average number of looms per operative in the associated mills is 5·5 against 3 on the Continent, and 4 in England, shows that there is a considerable advantage there.

"For the present I consider that Japan has reached its saturation point, particularly as the Japanese have built in China a large number of mills, which, of course, affect the export figures of Japan; but the Japanese are extreme optimists, and they will not stop cotton-mill building, since cotton mills pay better than any other industry in Japan."

558. MEXICAN COTTON INDUSTRY. (Abstr. from *Int. Cot. Bull.*, vii., **28**, 1929, p. 683.) The cotton-mill industry in Mexico is in a somewhat depressed condition, and production has decreased. Figures of production are given.

559. COTTON PRODUCTION IN PERU (trans. title). By H. V. Geib. (*Estac. Exp. Agr. Soc. Nac. Agr.*, Lima, *Circ.* 9, 1928. Abstr. from *Exp. Sta. Rec.*, lx., **9**, 1929, p. 816.) Practical information on the subject.

560. RUSSIA. We have received a copy of *Khlopkovoye Dielo*, Nos. 5-6, Moscow, 1929. Among the articles contained in the volume are the following (in Russian): "The Cotton of the East and U.S.S.R.," by A. Khodorof; "Gossypol," by F. Ushkalov; "The Effects of Poisons on the Chief Cotton Pests," by P. Galakhot.

561. KENDYR PLANT. CULTIVATION IN RUSSIA. (*Textilberichte*, **10**, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **11**, 1929, M. 10.) The bulletin published by the Kendyr Bureau, which is attached to the Russian Cotton Committee, contains a series of papers on the cultivation, physical and chemical properties, and economic value of the kendyr plant (*Apocynum venetum*), a fibre plant which grows wild on the shores of rivers and lakes of Central Asia.

562. RUSSIA. COTTON PROSPECTS. (*Int. Rev. of Agr.*, Rome, July, 1929.) An increased area has been planted to cotton, and there will be a larger available supply and a better system of distribution of irrigation water.

563. SMYRNA. COTTON PRODUCTION AND COTTON GOODS INDUSTRY. A report recently received deals with the climatic conditions, seed question, cultivation methods, ginning, grading, crop statistics, prices, shipping costs, exports, etc.

564. SPAIN'S NEW SHUTTLELESS LOOM. (Abstr. from *Int. Cot. Bull.* vii., **28**, 1929, p. 630.) The loom has two, if not three, entirely new movements. An illustration of the loom is given.

565. LA CULTURE DU COTONNIER DANS L'ETAT DE SYRIE EN 1928. By E. Achard. (*Coton et Cult. Coton.*, iv., **1**, 1929, p. 91.)

566. TURKESTAN COTTON CROP. (Abstr. from *Text. Rec.*, xlvii., **556**, 1929, p. 66.) It is reported that forty Soviet airmen are engaged in a chemical warfare against a horde of locusts which is threatening the destruction of the cotton crop in Turkestan. An area of 750,000 acres is threatened.

CULTIVATION AND MACHINERY : IRRIGATION, ETC.

567. CLIMATOLOGY AND SOME OF ITS APPLICATIONS. By R. De C. Ward. (*Sci. Mo.*, **28**, 1929, No. 2. Abstr. from *Exp. Sta. Rec.*, lx., **6**, 1929, p. 505.) This article defines climatology as distinguished from meteorology, and indicates some of the ways in which it "is applied in the service of man," for example, as related to plant distribution and growth, grasslands and grazing, rubber and cotton production, etc.

As regards possible extension of the cotton-growing area, it is stated that South America may soon take a more important position in the world's cotton markets than it does today.

568. SOWING TIME FOR COTTON. (Abstr. from *Seasonal Notes*, Punjab Agr. Dpt., vi., **1**, 1929, p. 46.) Experiments carried out at Lyallpur during the last three years appear to indicate that cotton sown late has a greater rate of growth and an increased boll production than the earlier sown crop. The experiments in connection with sowing dates have, however, not been considered in conjunction with certain watering and manurial experiments which are in progress, and which may affect the practical aspect of late sowing.

569. RESULTS OF COTTON VARIETY DEMONSTRATIONS, 1928. By P. H. Kime and S. J. Kirby. (*N. Carolina Sta. Agr. Inform. Circ. No.* 20, 1929. Abstr. from *Exp Sta. Rec.*, lx., **8**, 1929, p. 735.) The higher yielding cottons normally stapling from 1 to $1\frac{1}{16}$ in. such as Mexican and certain Cleveland strains, were more profitable than varieties with shorter staple, and are indicated for light to medium soils. For heavy, poorly drained soils the earlier, lighter foliaged sorts—*e.g.*, Carolina Foster—seemed better adapted.

570. COTTON VARIETIES. By J. F. O'Kelly and W. W. Hull. (*Circ. No.* 82, 1928, Miss. Agr. Exp. Sta.) Contains a summary of cotton variety test work done at the Central Station during the last five years, and the results in detail for 1928.

571. A CRITERION OF THE DIFFERENTIATION OF VARIETIES OR OF EXPERIMENTAL AREAS WITH RESPECT TO THEIR CAPACITY TO PRODUCE SEEDLING STANDS OF

COTTON. By J. A. Harris *et al.* (Abstr. from *J. of Agr. Res.*, vol. xxxviii., No. 11, 1929, p. 601.) The primary purpose of this paper is to give and to illustrate the applicability of criteria for the determination of differences in the seedling stands produced by different varieties of cotton when grown under the same conditions, and by the same variety of cotton when grown under different field conditions.

Pearson's double χ^2 criterion, which compares all the classes involved in the two frequency distributions, is shown to be a suitable test of differentiation in such cases.

Incidentally, comparisons between the seedling stands produced by a number of varieties, as grown under irrigation in Southern Arizona, are made. Pima Egyptian cotton showed a marked superiority over the Upland varieties with which it was compared in its ability to establish seedling stands under the rather saline soil conditions of the Gila River Valley of Southern Arizona. Sea Island cotton seemed to show a behaviour similar to Pima Egyptian in this respect.

572. EMPLOI DES ENGRAIS POUR LE COTONNIER EN ALGÉRIE. By L. Gibier. (*Rev. Agr. de l'Afrique du Nord.* Abstr. in *Coton et Cult. Coton.*, iii., **3**, 1928, p. 243.)

573. EFFECT OF SULPHUR ON NITRIFICATION. (Abstr. from *Rpt. of the Govt. Chemist*, 1928, Wellcome Trop. Res. Laboratories, Khartoum.) The somewhat disappointing returns obtained when cotton is manured with sulphur may be due in part to slowing down of nitrification. In a series of pot experiments which, by courtesy of the Director, were carried out at the Rothamsted Experimental Station, mixtures of Gezira soil (200 grams air dry) with and without sulphur (0·1 gr., which equals about 0·75 tons per acre) were moistened with 60 cc. of water or of solutions containing calcium cyanamide (0·3333 gr. per litre) or ammonium sulphate (0·3000 gr. per litre). Estimations of nitrate, ammonia and soluble salts were made 2, 8, 29 and 73 days after make-up, and it appeared that sulphur strongly retarded nitrification in soil receiving no added nitrogen, and slightly retarded nitrification in soil to which calcium cyanamide or ammonium sulphate has been added. The ammonia content of the soil fell off with time, and in the case of soil treated with sulphur, the soluble salt content rose, thus showing that oxidation of sulphur, under the conditions of this experiment, required two or three months for completion.

574. THE GERM CONTENT AND ACTION OF VARIOUSLY HANDLED MANURE. (trans. title.) By W. Goeters. (*Landw. Vers. Sta.*, **108**, 1929. Abstr. from *Exp. Sta. Rec.*, lx., **8**, 1929, p. 718.) It is shown that the temperature of formentation has a pronounced influence on the number, kind, and activity of organisms in manure. High temperatures (60 to 80° C.) as well as low (0°) reduced the number of organisms. Most of the vegetative organisms were killed at the higher temperatures. The urea bacteria were found to be among the more resistant organisms, and to play an important part in the ripening of manure. The survival and behaviour of the organisms varied in different parts of the manure heap. Hot-fermented manure showed a higher nitrifying capacity when mixed with soil. more readily assimilable nitrogen, and increased crop yields more than that fermented at lower temperatures.

575. FERTILIZING COTTON. By C. B. Anders. (*Circ. No.* 83, Miss. Agr. Exp. Sta., 1929.) An elementary guide to the use of fertilizers.

576. FERTILIZERS AND MANURES. By Sir A. Daniel Hall, Sc.D., F.R.S. (Third ed., revised and enlarged. John Murray, London, 1929. Price 8s.) (Abstr. from *Bull. of the Imp. Inst.*, xxvii., **2**, 1929, p. 262.) The new edition of this standard work has been rendered necessary by the great advances which have recently been made in the processes employed for the manufacture of artificial manures, and by the change in the economic position of fertilizers, a change which has been so considerable as to lead to new developments in farming. Revision was also needed in view of the new additions to our knowledge of the soil and the action of fertilizers on it. The work has been thoroughly revised and enlarged, and is as indispensable as ever.

577. COTTON FERTILIZERS AND CULTURAL METHODS. By R. P. Bledsoe. (*Bull. No.* 152, 1929, Exp. Sta. Ga.) When used as the sole source of nitrogen and based on present prices, highest returns were obtained from the quick-acting inorganic sources such as calcium nitrate, sodium nitrate, and ammonium sulphate.

578. FERTILIZER EXPERIMENTS WITH CROPS. (*S. Carolina Sta. Rpt.*, 1928. Abstr. from *Exp. Sta. Rec.*, lx., **8**, 1929, p. 717.) Potassic fertilizer increased seed-cotton yields from 530 to 800 lb. per acre, as compared with but 240 lb. per acre where the potassium was not supplied. The application in another experiment of 800 lb. per acre of " high-grade fertilizer " increased the seed-cotton yield from 140 to 893 lb.

579. FERTILIZER EXPERIMENTS IN SOUTH CAROLINA. (*S. Carolina Sta. Rpt.*, 1928. Abstr. from *Exp. Sta. Rec.*, lx., **8**, 1929, p. 733.) Fertilizer experiments on different soil types led to the conclusion that nitrogen is the first limiting factor in cotton production in the State and phosphorus next.

Fertilizer placement studies gave indications that in general the closer the fertilizer is placed to the cotton seed without impairing germination the more efficient it is in increasing yield. A placement which causes a slight injury to stand quite often returns a better final yield. Placing the fertilizer in bands on either side and at the same level as the seed appears most satisfactory when both germination and final yield are considered.

A relatively small proportion of the nitrogen seemed to be required from organic sources.

580. NEW FERTILIZER MATERIALS AND THEIR USES. By J. J. Skinner. (*N. Carolina Sta. Agron. Inform. Circ.* 22, 1929. Abstr. from *Exp. Sta. Rec.*, lx., **8**, 1929, p. 719.) The following fertilizers are described, and given brief individual discussion: ammonium nitrate, ammonium chloride, ammonium phosphate, ammophos, diammophos, urea, urea phosphate, calcium nitrate, potassium ammonium phosphate, calurea, nitrophoska, potassium ammonium nitrate, leunaphos, and leunaphoska. The effect of concentrated fertilizers in the growing of cotton on North Carolina soils is discussed. After showing from the results of experiments that there is some danger of crop injury in the use of very concentrated mixtures, even when the fertilizer is applied ten days prior to planting, the author concludes that " the practical compromise may well be the production of fertilizer mixtures not of extreme concentration, but still considerably more concentrated than the present average commercial fertilizer."

581. NITROGENOUS FERTILIZERS. It is officially announced that an agreement has been arrived at between the Chilian Finance Minister, Senor Pablo Ramirez, and Imperial Chemical Industries Limited, having for its purpose closer co-operation between Synthetic Nitrogen and Chilian Nitrate of Soda, on similar lines to the agreement concluded between the Chilian Finance Minister and the I. G. Farbenindustrie A. G., which agreement is being announced concurrently. An agreement has also been concluded between Imperial Chemical Industries Limited and the I. G. Farbenindustrie A. G., with regard to co-operation between those two Companies in the production, marketing, and propaganda of Synthetic Nitrogen products. The agreements provide for a common policy to be pursued in the future regarding propaganda and similar matters relating to fertilizers. A substantial basis for the stabilization of the nitrogen industry has thus been reached, and it should be noted that this stabilization is accompanied by a substantial reduction in the prices of nitrogenous fertilizers amounting to 10s. per ton, which is a matter of great importance to the agricultural industry of the world.

582. Experiments with Nitrogenous Fertilizers at Shambat. (Abstr. from *Rpt. of the Govt. Chemist*, 1928. Wellcome Trop. Res. Laboratories, Khartoum.) During the past season the only experiment tried with nitrogenous fertilizers was a comparison between ammonium sulphate and urea, which gave disappointing results. The experiments were carried out on Hosh 9 Feddan 2. Two cwts. per acre were used of each fertilizer, but the amounts of nitrogen were, of course, quite different, being 40 lb. from the ammonium sulphate and 93 from the urea. The fertilizers were applied in two stages, half at the time of sowing on September 19 and half on December 7, when the regular analyses showed the first marked drop in nitrate content, which was at the middle of December. The yields of seed-cotton were:

	Lb. per Acre.
Control	650
Ammonium sulphate	741
Urea	664

583. Nitrate of Soda Experiments, 1928. By W. B. Rogers. (*Circ.* 36, 1929, S. Carolina Agr. Exp. Sta.) Results of experiments to determine the most efficient time and rate of application of nitrate of soda to cotton, corn, and oats, as conducted by the Agronomy Division of the South Carolina Experiment Station in 1928, are reported.

The increases in pounds of seed-cotton per acre from applications of nitrate of soda were as follows:

	Lb.
100 lb. nitrate of soda at planting	177
100 ,, ,, ,, ,, ,, planting 100 ,, ,, ,, ,, ,, chopping	157
100 ,, ,, ,, ,, ,, planting 200 ,, ,, ,, ,, ,, chopping	183
100 ,, ,, ,, ,, ,, planting 300 ,, ,, ,, ,, ,, chopping	63

Where an application of 200 lb. of nitrate of soda was made to cotton at different stages of growth, the highest yield was obtained from the application of one-fourth at planting and three-fourths at chopping.

584. The Quality and Yield of Cotton as Influenced by Fertilizers and Soil Type. By J. J. Skinner. (*N. Carolina Sta. Agr. Inform. Circ.* 21, 1929. Abstr. from *Exp. Sta. Rec.*, lx., 8, 1929, p. 735.) Significant observations are reported from experiments in co-operation with the U.S. Dept of Agriculture, wherein the response of cotton in growth and in yield and quality of lint when receiving fertilizers containing varying proportions of phosphorus, nitrogen, and potassium was studied on important soil types in North Carolina.

[*Cf.* Abstract **583**.]

585. Liming of Tropical Soils. By R. R. Follett-Smith. (Abstr. from *Agr. Jour. of Brit. Guiana*, ii., **2**, 1929, p. 61.) Work in Trinidad has demonstrated that the lime status of soils which are subjected to intense leaching, and upon which no system of rotation is practised, is a question of paramount importance, and should receive ample consideration prior to the formation of a manurial campaign employing other mineral fertilizers. This article describes the beneficial effects to be obtained by an adequate application of limestone to calcium-deficient soils. It also outlines the deleterious factors operating upon crop plants growing in acid soil environments. In the light of work recently carried out in Trinidad the use of pulverized limestone as a source of lime is advocated. A specification for pulverized limestone is described. The application and duration of effect of dressings are discussed, and laboratory methods applicable to the study of the lime status of soils are suggested.

586. THE H-ION CONCENTRATION OF EGYPTIAN SOILS. By R. R. Le Geyt Worsley. (*Tech. and Sci. Serv. Bull. No.* 83, Min. of Agr., Egypt, 1929.)

1. All Egyptian soils, so far examined, are alkaline—that is, they have a pH above 7.

2. Most of the soils exhibit a buffer action on addition of acid or alkaline substances, and show a buffer space round about the pH value 7; this space varies slightly for different soils.

3. Various acid substances have been tried for the reclamation of alkaline soils, and sulphuric acid was found to be the most efficient. The reduction in pH when the soil is subsequently washed is never as great as when the acid substance is merely added *in vitro.*

4. Addition of neutral salts to a soil causes a reduction in pH, depending on the quantity and nature of the salt added. The reduction is probably due to base exchange.

5. The leaching of a salty soil causes a rapid rise in both pH and impermeability, the percolated water containing relatively large amounts of calcium salts. In most cases a base exchange between the sodium chloride and the calcium carbonate in the soil occurs, with formation of sodium carbonate.

6. The presence of much soluble matter in a soil depresses the pH and renders it useless as an indication of the fertility of the soil. A table has been prepared for the purpose of calculating back the pH of such a soil to zero salt content, and by means of it an approximate idea of the soil fertility can be ascertained.

587. THE PROPERTIES OF HEAVY ALKALINE SOILS CONTAINING DIFFERENT EXCHANGEABLE BASES. By A. F. Joseph and H. B. Oakley. (*J. of Agr. Sci.*, xix., 1, 1929.) The nature of the replaceable base in a clay or soil exerts a profound effect on the physical properties. Clay-like properties are exhibited most strongly in the case of lithium, sodium, and magnesium.

The proportion of fine material in a soil (*i.e.*, that which remains in suspension in a column 10 cm. high after fourteen days) cannot be correlated with other physical properties. Thus a soil of which over 50 per cent. was dispersed to this extent was the least plastic of those examined.

A comparison of sodium, potassium, and calcium clays and soil showed that potassium resembles sodium in its chemical relationships as indicated by base exchange, but is very different from it in such physical properties as plasticity and permeability.

Using mixtures of one-half normal chlorides of two bases, calcium and potassium are absorbed in equivalent amount, while the sodium absorbed is only one-sixth of the amount of either of the other two.

588. THE DISPERSION AND MECHANICAL ANALYSIS OF HEAVY ALKALINE SOILS. By A. F. Joseph and O. W. Snow. (*J. of Agr. Sci.*, xix., 1, 1929.) The form of the dispersion curve obtained by single dispersion treatment below 2μ varies greatly with different soils and with the same soil saturated with different bases. There is no connection between the proportion of very fine material (*e.g.*, below 0·5μ) and other important soil properties. The proportion of the very fine material determined in this way would not, therefore, afford any indication of the "colloid" properties of the soil. If the proportion of fine material were estimated by a decantation method the results might be substantially modified.

Under the same conditions of dispersion sodium soil is better dispersed than ammonium. Sodium carbonate should therefore be the best medium for mechanical analysis.

No case has been met with where the proportion of clay found is affected to an important degree by the use of hydrogen peroxide.

With no soil tried was the number of decantations reduced by the use of acid pre-treatment; those examined gave the same clay content if sufficient puddlings with sodium carbonate were used with or without acid.

No method has been found whereby certain soils can be dispersed in a single operation as is required in the pipette method. In some cases this is due to gypsum, but there are others in which the cause of the difficulty of dispersion is not yet known.

In the cases examined sodium carbonate gives a higher result than ammonia when using the international pipette method.

For Sudan soils decantation methods appear essential, hydrogen peroxide unnecessary, acid pre-treatment not essential, and sodium carbonate better than ammonia. The authors are of opinion that the same holds good for many other soils.

589. COTTON-PICKING MACHINE. By H. Wade, London. (W. Morava, Chicago. E.P. 309,660 of February 3, 1928. Abstr. from *Summ. of Curr. Lit.*, ix., **14**, 1929, E. 21.) The machine has rotating picking fingers from which the cotton is stripped by circular saws. It is removed from the saws by brushes, and is drawn up suction pipes into a fan, from which it is discharged by a pipe into a suitable receptacle.

590. NEW COTTON PICKER. (Abstr. from *Int. Cot. Bull.*, vii., **28**, 1929, p. 588.) The new machine uses a wiping principle, and no air suction. The model going on the market this year is of the size of a motor cycle, weighs around 300 lb., rolls on three wheels, and carries its own bag holding about 100 lb. of seed-cotton. It will pass between rows as narrow as 30 inches wide—where the plant growth is not higher than 5 feet—as often during the picking season as is desired, without injury to the plants. The machine requires two operators, and the cost is $475.

591. INFLUENCE OF COTTON-PICKING METHODS ON GINNING PRACTICE. (Abstr. from *Man. Guar. Coml.*, July 1, 1929, p. 49.) Points out that the progress of the snapping and sledding methods of cotton-picking has been the cause of many of the recent improvements in ginning machinery, which have taken the form of boll extractors and cleaning devices—for example, sand extractors and hullers.

592. COTTON GINNING. By R. W. Webb. (*U.S. Dpt. of Agr. Div. of Cot. Marketing Rpt.*, April, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **14**, 1929, E. 21.) A preliminary report on problems and research methods in cotton ginning.

593. COTTON-GINNING EXPERIMENTS. (Abstr. from *Text. Rec.*, xlvii., **554**, 1929, p. 42.) The Division of Cotton Marketing, U.S. Bureau of Agricultural Economics, in co-operation with the Texas Agricultural Experiment Station, is making two important studies on cotton as the result of recently completed agreements. The first relates to the effects of the different methods of cleaning and extracting cotton at the gin on the physical properties of cotton fibres. The second relates to the effect of variations in the ginning process on the physical properties of Upland cotton.

There is very little published data concerning ginning machinery, organization, and operation. Gins are operated in various ways. Some are run with relatively slow saw speeds, others fast; some are run with tight, medium, and loose roll settings; some are run with saw teeth in perfect condition, others with dull tooth points. In some cases the seed-cotton to be ginned is too wet; by many it is claimed that cotton may be ginned too dry. The second study is the first of a series which it is hoped eventually to extend to cover all these points.

594. GINNING: EFFECT ON COTTON QUALITY. By K. K. Hoyt. (*Text. World*, 1929, **75**. Abstr. from *Summ. of Curr. Lit.*, ix., **12**, 1929, E. 18.) As an example of the effects which ginning may have on cotton, two arrays from the same lot of seed cotton are shown, one with the fibres removed from the seed by hand and the other by commercial ginning. The uniformity of the fibre lengths has been greatly disturbed by the gin, with the result that the percentage of short fibres has increased. The effect is shown in graphs prepared from the machine-sorting of larger samples. Factors associated with the ginning operation are discussed, and a number of primary questions to which the answers are yet to be found are propounded. A programme of investigation designed to determine the effects of different conditions is outlined.

[*Cf.* Abstracts **526**, **591**, **652**.]

595. COTTON PLANT: RATOONING IN MOROCCO. By E. Miège. (*Int. Rev. Agr.*, **19**, 1928. Abstr. from *J. of Text. Inst.*, xx., **5**, 1929, A. 231.) Ratooning of the cotton plant should be done before vegetation recommences, with a different technique according to the countries considered. In Algeria ratooning is practised for three years, and during variable periods in New California, the Sudan, and Senegal. The disadvantages of the operation are the production of refuse and multiplication of pests. For the latter reason ratooning has been forbidden in Egypt and in certain of the States of America. However, owing to the early seasonal ripening induced by the method, the ratooned plantations of North Africa are not more liable to attack than annual plantations. The refuse may vary from 2 to 5 per cent. or more (especially in Haute-Volta), but this is solely due to faulty technique and to local conditions. The refuse is considerable if the soil is cold. The advantages are quicker ripening (four to six weeks), and the need of less water, the ratooned cotton plant requiring two irrigations less. The yields are increased, but generally the quality is not good. In this respect, however, Algeria and Morocco are exceptions.

596. THE IMPROVED "SEGUNDO" COTTON-SEED DEFIBRATING MACHINE. (Abstr. from *Int. Cott. Bull.*, vii., **28**, 1929, p. 658.) The output of this machine has been increased between four and five times by recent improvements, without, however any increase in the size or the cost.

597. COTTON-SEED PODS: DEFIBRATING. By P. H. Minck. (Berlin, E.P. 310, 847 of May 1, 1928. Abstr. from *Summ. of Curr. Lit.*, ix., **14**, 1929, E. 21.) Cotton-seed pods are treated to separate the husks from the fibres by passing them into a casing containing rotary beaters arranged in a downwardly converging helix. The casing is provided with a cooling jacket through which water or brine passes. Another cooling jacket surrounds the upper part of the casing. A fan, arranged above the beaters, draws the freed fibres upwards from the casing.

598. REMOVAL OF COTTON STALKS. By W. G. Wells. (Abstr. from *Queens. Agr. J.*, xxxi., **6**, 1929, p. 421.) Describes a machine for the removal of cotton stalks after harvesting operations. The machine is stated to be a modification of the ordinary maize slide-cutter, and can be constructed at small cost.

PESTS AND DISEASES.

599. THE INTERNAL CONDITION OF THE HOST PLANT IN RELATION TO INSECT ATTACK, WITH SPECIAL REFERENCE TO THE INFLUENCE OF PYRIDINE. By J. Davidson and H. Henson. (*Ann. Appl. Biol.*, xvi., **3**, 1929, p. 458.)

600. Preliminary Experiments with Dusting and Spraying against Insect Pests of Cotton. By I. Bishara. (*Bull. No.* 77, Tech. and Sci. Serv. Min. of Agr., Egypt, 1928.) A reduction of 53 per cent. in pink bollworm and 66 per cent. in spiny bollworm infestation was obtained in small-scale experiments by dusting with sodium fluosilicate. The effect of the dust on the cotton plant itself was practically nil, and the plants were also free from aphis attack which usually follows dusting with arsenicals. Spraying experiments carried out with castor oil showed that this oil is decidedly repellent to pink bollworm and spiny bollworm. This treatment is rather costly, but there may be a margin of net profit. The oil is harmless to man and animals. Dusting experiments with calcium arsenate and Dusturan (a dilute form of Paris green) gave much lower reductions of infestation than sodium fluosilicate, and, in addition, the plants thus treated were badly attacked by cotton aphis. The Cotton Leaf Worm (*Prodenia litura*) also attacks clover, and dusting of this crop with sodium fluosilicate proved very successful; it is hoped to try the effect of this dust on cotton infested with *Prodenia litura* next season.

601. La Destruction des Insectes Nuisibles par les Rayons "Ultra-Violets." By G. Gourdon. (*Prog. agr. vitic.*, xci., **9**, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 6, 1929, p. 332.) Numerous observations and experiments have demonstrated the effectiveness of cathodic rays in destroying injurious insects, and ultra-violet rays have been found to attract both diurnal and nocturnal species. The rays appear to produce in the insects a sensation that is at first agreeable. but which soon becomes dangerous, if not fatal; in certain cases they are immediately blinded. A trap apparatus for use in vineyards, orchards or fields is described, to which insects are attracted by means of ultra-violet rays, and are either drawn by the suction of an electric fan into a metal basket or fall blinded outside the trap, where they become an easy prey to birds.

602. Cotton Plant Insect Repellent: Application By W. Eggert. (*Chem. Abstr.*, **23**, 1208. From U.S. P. 1,698,539 of January 8, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **8**, 1929, E. 15.) Cotton plants have supplied to their roots during the blossoming period a fermented solution prepared from cotton-plant leaves and blossoms, together with a saccharine compound such as sugar or molasses and an extract of sassafras leaves, for the purpose of repelling attacks of insects, etc.

603. Zielen Paryska oraz Zastosowanie jej w Walce ze Szkodnikami Roslin (Paris Green and its Application in the Control of Insect Pests). By K. Strawinski. (Pub. Sta. Pl. Prot. Zgierz. Poland, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 7, 1929, p. 402.) The composition and properties of Paris green are discussed in detail. Instructions are given for its employment in the preparation of liquid and dust insecticides, and the technique of spraying, dusting, and the use of poisoned baits is described.

604. Plant Protection by Aeroplane: Poison Clouds disseminated over Cotton Fields. (Abstr. from *Man. Guar.*, May 18, 1929.) A popular account of the spraying of dusts upon the boll-weevil-infested cotton fields by means of aeroplanes, pointing out that this method of insect control has come to stay.

605. Biological Control. By J. G. Myers, Sc.D. (Abstr. from *Trop. Agr.*, vi., **6**, 1929, p. 163.) Discusses the principles of biological control.

606. The Biological Method of Controlling Insect Pests. By V. V. Nikol'skii. (In Russian.) (*Khlop. Dielo*, viii., **1**, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 5, 1929, p. 289.) A general discussion on the importance and efficacy of the biological method of controlling insect pests, particularly by the introduction of their natural enemies, with detailed notes on its successful application in various parts of the world. The history of the origin of this method is briefly reviewed, and the difficulties involved in its application are pointed out.

607. ON THE RELATIVE VALUE OF PARASITES AND PREDATORS IN THE BIOLOGICAL CONTROL OF INSECT PESTS. By W. R. Thompson. (*Bull. Ent. Res.*, xix., 4, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, 6, 1929, p. 348.) The author discusses the relative value of insect parasites and predators in the biological control of their insect hosts. An enumeration of the predacious and parasitic families shows the former to be much more varied in structure, habits, and distribution than the latter. The general idea that predators are less reliable in biological control than parasites is due chiefly to the belief that they are less specific in their choice of hosts. The author believes this supposition to be incorrect, and, in point of fact, there seems to be relatively little difference in the specificity of polyphagous parasites and predators. Again, the author does not agree with the largely accepted theory that oligophagous or polyphagous parasites are markedly inferior to monophagous species in the control of pests. The polyphagous species will always distribute its progeny among several hosts in proportions depending upon its individual preferences and the relative numbers of each species available; if one of the hosts begins to increase, that host will tend to receive a greater proportion of eggs or larvæ, unless it is only slightly attractive. The parasites with high reproductive rates are not necessarily the most effective, for the method of oviposition is frequently extremely wasteful; there does not seem to be, in fact, any striking difference in the effective rate of reproduction of parasites and predators. Moreover, each individual predator devours a large number of insects during its life, whereas the parasite destroys one at the most. Mathematical calculations are given showing the length of time necessary for the annihilation of a given host population by given populations of gregarious parasites, solitary parasites, and predators. Other things being equal, a predator that devours 100 hosts during its life will reduce an outbreak 100 times as fast as a solitary parasite, and 1,000 times as fast as a gregarious parasite depositing ten eggs in each host attacked, provided that the reproductive rates of host and enemy are equal. The difficulty of detecting the work of predators and estimating their importance, as compared with that of parasites, is considerable, and equations are used to show the relations necessary between the numbers and reproductive rate of a beneficial insect and those of its host if control is to be effected. The destruction of many hosts during the life of a predator will often compensate for a low rate of reproduction.

These theoretical conclusions concerning the value of predators are strongly supported by the results obtained in practical biological control work. The relative importance of the two types of controlling agencies in any given case can, however, only be decided by careful investigation in the field.

608. LEAFHOPPER AND THE TRAP LIGHT. By P. B. Lawson. (*J. Kansas Ent. Soc.*, ii., 2. McPherson, Kansas, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 7, 1929, p. 367.) The observations described were made at Lawrence, Kansas, during 1928. A 200-watt Mazda bulb was suspended under a suitable shelter, which protected the whole trap. About 6 inches below the light was a funnel nearly 2 feet wide that tapered to a tube 4 inches in diameter and about 18 inches long, which was divided into three sections; the lowest was 3 inches long and contained potassium cyanide in a perforated tin box; the one above, about 6 inches long, had near its lower end a wire screen of about nine meshes to the inch. On the top of the funnel was another screen of four meshes to the inch. Most of the insects that fell into the lowest section were leafhoppers, of which 126 species and varieties were taken, an average of over 1,000 a night being captured on seventy nights. A list of the species is given, with notes on the life-histories of some of them, based on data from the catches

609. CONTROL OF THE COTTON BOLL WEEVIL BY INSECT ENEMIES. By E. F. Grossman. (*Science*, lxix., 1787, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 6, 1929, p. 358.) In the United States, *Anthonomus grandis*, Boh., has about fifty-five insect enemies, including parasites and predators, all of which are indigenous and were present in the cotton zone before the weevil, which was established in the entire zone by 1922, was introduced. They attack fifty-two other weevils, feeding on ninety-one other species of plants. Since 1923 there appears to be a lessening of damage to cotton caused by the boll weevil, though severe local infestations have occurred. In the author's opinion a more extensive study of its natural enemies will indicate that they are generally becoming more important in limiting the damage done.

610. FLORIDA LONGEVITY RECORDS OF THE COTTON BOLL WEEVIL. By E. F. Grossman. (*Flor. Ent.*, xii., **4**, 1928. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 5, 1929, p. 278.) Of 5,000 adults of *Anthonomus grandis*, Boh. (cotton boll weevil) placed without food in a hibernation cage in November, 1927, the emergence of which was observed from March 1 until August 9, 1928, 11·24 per cent., or 562 weevils emerged, the last on July 16, after having spent 237 days without food in the hibernation cage. In order to determine the number of days that weevils could live after hibernating, all those emerging after June 14 were provided with fresh cotton squares and placed individually in lantern globes kept in an insectary under approximately normal conditions. Longevity records show that one of these weevils lived 143 days after emergence from hibernation, and another lived a total of 372 days (238 in hibernation and 134 afterwards).

611. PINK BOLLWORM IN THE PUNJAB. (*Rpt. of the Operations of the Dpt. of Agr.*, Punjab, 1928, Pt. 1, p. 29.) An experiment to control pink bollworm larvæ infesting cotton seed, by means of superheating and fumigation with CS_2, was tried, and it was found that in the case of infested seed heated to a temperature of 56° C. for 1¼ hours the larvæ were killed in all cases. In the fumigation experiment a dose of 1 ounce of CS_2 for 12 cubic feet space also gave 100 per cent. mortality results. In experiments with reduced doses the insect did not actually die but appeared unconscious for a time, and then revived again.

612. SAVE COMING COTTON CROP FROM BOLLWORM ATTACK. By L. Umrao Bahadur. (Abstr. from *Seasonal Notes, Punjab Agr. Dept.*, vi., **1**, 1929, p. 4.) As many as 200 to 250 eggs of the Spotted Bollworm (*Kapas kisundi*) were found in one day on a single hollyhock plant in Lyallpur. The bollworms feed on hollyhock plants till they are full grown, and then as moths fly to the cotton fields. The White Fly of cotton also breeds on hollyhock. The author suggests the early destruction of these plants in order to starve out the bollworms, and prevent them becoming a menace to the oncoming cotton crop.

613. PINK BOLLWORM IN TEXAS. (Abstr. from *J. of Econ. Ent.*, xxii., **3**, 1929, p. 626.) In February last the Texas legislature amended the pink bollworm law, "providing compensation for all losses incurred or expenses sustained by all persons, firms, or corporations required to comply with the provisions of" the pink bollworm law of 1921, and "providing for State ownership or lease of fumigation and sterilization plants."

614. LA "LAGARTA ROSADA" DEL ALGODONERO (*Pectinophora gossypiella*, Saund.). UNA PLAGA QUE NO QUEREMOS TENER EN TUCUMAN. By H. E. Box. (*Rev. ind. agric. Tucuman*, xix., 3-4, 1928. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 6, 1929, p. 309.) A popular review of the distribution and importance of *Platyedra* (*Pectinophora*) *gossypiella*, Saund., throughout the world, including notes on its control by the fumigation of cotton seed. The pest has not been recorded from Tucuman, though it occurs in other parts of Argentina.

615. PLANT DISEASES AND PESTS IN BOMBAY. (Abstr. from the *Ann. Rpt. of Dpt. of Agr., Bombay,* 1927-28, recently received.) The problem of cotton wilt is the subject of a special research scheme at Dharwar financed by the Indian Central Cotton Committee. It has been found that there is a definite range of soil temperature below and above which the associated Fusarium fungus perishes. At Dharwar Farm two strains of wilt-resistant cotton are in process of development.

The problem of the spotted bollworm is also the subject of a special research scheme financed by the Indian Central Cotton Committee. It is stated that the caterpillar of this pest passes down into the soil to pupate, and it cannot do this if the soil is effectively mulched. The feasibility of controlling the pest through this discovery is under investigation.

616. NOTAS SOBRE EL "ARREBIATADO" EN PIURA. (Notes on *Dysdercus ruficollis* in Piura.) By J. B. Poppe. (*La Vida agric.,* vi., **61,** 1929. Abst. from *Rev. App. Ent.,* xvii., Ser. A, Pt. 6, 1929, p. 319.) In the Piura Valley, Peru, cotton plants infested by the cotton stainer (*Dysdercus ruficollis,* L.) produced 33 per cent. of stained cotton. In plants protected by covers only 5 per cent. of the cotton was stained. The bugs seem to breed in greater numbers from September to November than from June to August; a high degree of humidity is unfavourable to reproduction. Hand-collection gave fair results from May to July. Dates for sowing cotton in various localities so that the crop may be harvested when the bugs are at their minimum are indicated. All cotton plants should be destroyed immediately after the harvest.

617. COTTON FLEA HOPPER (*Psallus seriatus,* Reut.) STUDIES OF 1927 AND 1928. By C. O. Eddy. (*Bull. No.* 251, 1928, S. Carolina Agr. Exp. Sta.) Life-history studies are reported. There are two phases to the cotton leafhopper problem in South Carolina—*i.e.,* first, injury to seedling cotton, and second, injury to the squares. Cage experiments with seedlings show that both nymphs and adults injure terminal buds and cause abnormal and retarded growth. Clean culture and the destruction of alternate host plants are recommended as useful control measures. Sulphur dust is the most effective insecticide.

618. THE BIOLOGY OF THYSANOPTERA WITH REFERENCE TO THE COTTON PLANT. By E. I. MacGill. (*Annals of App. Biol.,* xvi., May 2, 1929, p. 288.) Results of experiments with Webber cotton on the effect of water supply on the infestation of a plant by thrips suggested that the surface caking of the soil has an important influence on the degree of infestation. This was greater in pots where the soil surface was tilled.

619. WOOLLY-MITE (*Eriophyes gossypii*) ON COTTON. By B. J. Thakar and M. H. Desai. (Abstr. from the *Agr. J. of India,* xxiv., **3,** 1929, p. 175.) Woolly-mite is a serious and widespread pest of cotton. It is reported from Bombay and from various other provinces of India, and is very virulent in the Surat and Broach Districts of Gujurat. Plants completely affected by this pest give 30 per cent. below the normal yield of seed-cotton. Various control measures that have been tried are discussed in detail, but none of them have proved effective. Application of sulphur, which is generally considered the best remedy against mites, damaged the cotton by causing shedding of the leaves, buds, and young bolls. Polysulphide is not toxic to the cotton plant, but has no effect in killing woolly-mites.

620. EGYPT: COTTON PESTS. (Abstr. from *Int. Cot. Bull.,* vii., **28,** 1929, p. 641.) A report from the Ministry of Agriculture in May is to the effect that cutworm attack in the provinces of Lower Egypt and in Minia Province is more widely spread than last year. Cotton-worm eggs were noticed in Daqahlia Province and in other provinces of Lower Egypt, but were immediately collected. Attacks of aphis were confined to a few areas in the provinces of Gharbia and Kaliubia.

621. STUDIES OF INSECT PESTS AT THE SOUTH CAROLINA STATION. (*S. Carolina Sta. Rpt.*, 1928. Abstr. from *Exp. Sta. Rec.*, 60, 8, 1929, p. 754.) A new cotton pest reported in the State for the first time is a cotton beetle (*Luperodes varicornis*, Lec.), previously recorded from Georgia and North Carolina, but now found in McCormick County, where it damaged the blooms and squares.

Studies were made of a yellow thrips found to have been common on cotton during the period when seedling injury occurred, and reference is made to a second species much less commonly met with. The yellow thrips was found to develop in from fourteen to twenty-two days, the incubation period having averaged from five to six days, and the development of the immature form from seven to eight days. Control is obtained by the use of nicotine sprays and nicotine oil emulsion.

622. UN NOUVEL ENNEMI DU COTONNIER (*Col. curculionidæ*). By A. Hustache. (*Bull. Soc. Ent. Fr.*, No. 4, Paris, 1929. Abstr. *Rev. App. Ent.*, xvii., Ser. A, Pt. 7, 1929, p. 411.) *Amorphoidea rufa*, sp.n., is described from Cambodia on cotton, to which it is injurious; it has also been taken in Tonkin.

623. NEW CURCULIONIDÆ (COL.) FROM CULTIVATED PLANTS. By G. A. K. Marshall. (*Bull. Ent. Res.*, xix, 4, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 6, 1929, p. 349.) Among the new weevils described are *Tanymecus arushanus* and *Systates habenatus* on cotton foliage in Tanganyika.

[See also Abstracts **476, 493, 494, 516.**]

624. SOME EXPERIMENTS WITH CALCIUM CYANIDE AS A CONTROL FOR PLANT PARASITIC NEMATODES. By W. E. H. Hodson and G. W. Gibson. (*Ann. App. Biol.*, xv., 4, 1928, p. 623.)

625. TWO NEW SCELIONID PARASITES OF *Locusta migratoria*, L., FROM RUSSIA. By A. A. Ogloblin. (*Bull. Ent. Res.*, 17, 1927. Abstr. from *Exp. Sta. Rec.*, 60, 7, 1929, p. 656.) A description of two new species of Scelio reared from eggs of *L. migratoria*, one in Poltava Province and the other in Turkestan.

626. RESULTS OF A SURVEY OF THE ACRIDIDÆ IN NORTHERN PERSIA IN 1927 AND 1928. By L. Moritz. (In Russian.) (Ashkhabad, Narkomz. Turkm. S.S.R. Stazra, 1928. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 5, 1929, p. 261.) Demonstrates the possibility of controlling the locusts *Schistocerca gregaria*, Forsk., and *Calliptamus italicus*, L., by poisoned baits. which gave good results, the northern part of Persia being cleared of locusts, though the south remained heavily infected.

627. THE ACRIDIDÆ OF THE LOWER VOLGA REGION. By S. A. Predtechenskii. (In Russian, with summary in English.) (*Comment. Inst. astrachan. Defens. Plant.*. ii., 1, 1928. Abstr. from *Rev. App. Ent.*, vol. xvii., Ser. A, Pt. 5, 1929, p. 261.) A very detailed account, with a list of species, and data on their distribution, ecology, phenology, etc. The species of economic importance dealt with are *Locusta migratoria*, L., and *Calliptamus italicus*, L. A list of natural enemies of Acrididæ is also included.

628. ANGULAR LEAF-SPOT DISEASE. (41*st Ann. Rpt. Ga. Agr. Exp. Sta.*, 1928. Abstr. from *Rev. App. Mycol.*, viii., 7, 1929, p. 426.) Excellent control of angular leaf spot of cotton (*Bacterium malvacearum*) was secured by treating the seed with 20 per cent. mercuric chloride dust (4 oz. per bushel), mercuric resinate dust (saturated), and Du Pont dust No. 12 (4 oz. per bushel), without delinting, as well as by thirty minutes' immersion in mercuric chloride after delinting with sulphuric acid. The last-named treatment, however, caused a considerable reduction of yield. None of these treatments proved effective in the control of cotton-root rot (*Fusarium moniliforme*), the seedlings in the test plots showing nearly 100 per cent. infection due to the presence of the organism in the soil.

629. ASPERGILLUS NIGER: CHARACTERIZATION. By K. Bernhauer. (*Biochem. Z.*, 1929, **205**. Abstr. from *J. of Text. Inst.*, xx., **6**, 1929, A. 339.) Investigations of the growth of various stocks of *Aspergillus niger* on acid substrates are described. There seems to be a connection between the acid-producing power and the acid-resisting power of the fungus. The results of experiments show that by suitable selection and culture on media containing hydrochloric acid, a stock having a considerably higher acid-producing power than the average can be obtained.

630. COTTON-WILT STUDIES. II. PRELIMINARY STUDIES OF WILT RESISTANCE AND OF THE EFFECT OF CERTAIN SOIL FACTORS ON THE DEVELOPMENT OF COTTON WILT. By C. H. Young *et al.* (*Bull. No.* 234, Univ. of Ark. Coll. of Agr., 1929.) The results of the tests at the Cotton Branch Experiment Station in Lee County in 1927, as well as the preliminary work at Galloway in 1926, demonstrate clearly the high degree of wilt resistance possessed by the so-called wilt-resistant varieties of cotton even when root-knot is a complicating factor. Certain of the new wilt-resistant varieties of cotton appear well adapted to Arkansas conditions, but others should be discarded because of certain undesirable features.

Organic fertilizers applied in the form of green manure did not function in reducing cotton wilt in controlled pot experiments in the greenhouse. Data to hand show that nitrite production in green manured soils may be greater than in soils fertilized with an inorganic nitrate fertilizer, even when the soil in both cases was inoculated with *F. vasinfectum*. Ammonia and nitrate determinations of soil fertilized with organic and inorganic nitrogen show no correlation with percentages of wilt secured. The strain of the cotton-wilt fungus used did not function as a reducing organism when grown in a solution using inorganic salts as a source of nitrogen.

631. VERTICILLIUM WILT OF COTTON. By C. D. Sherbakoff. (*Phytopath.*, xix., **1**, 1929. Abstr. from *Rev. App. Mycol.*, viii., **6**, 1929, p. 378.) The main field symptoms distinguishing the *Verticillium* wilt from that caused by *Fusarium vasinfectum* are complete shedding of the leaves, noticeable shedding of young bolls before the withering of the tips and branches, and an absence of any discoloration of the cambium, while new branches frequently develop at the base of the plant. The discoloration of the fibro-vascular bundles is common to both forms of wilt.

GENERAL BOTANY, BREEDING, ETC.

632. STUDIES IN INHERITANCE IN COTTON. THE IMPROVEMENT OF DHARWAR AMERICAN COTTON BY HYBRIDIZATION. By R. K. Kulkarni and T. R. Khadilker. (*Bull. No.* 189, Agr. Res. Inst. Pusa, 1929.) Deals with the subject under the following heads: (i) The history of the introduction of American cotton into India; (ii.) improvement of Dharwar-American cotton by selection; (iii.) attempts to produce improved cottons for the Dharwar-American tract by hybridization; (iv.) parents of the cross; (v.) the method of selfing and making the cross; (vi.) the characters of the hybrid plants: hairiness of the plants, colour of the spot on the pulvinus, number of teeth in the bracts, colour of the flower petals, presence of petal spot or "eye," length of the flower petal, colour of bolls, surface and glandulation of bolls, number of loculi in the bolls, length of staple of lint, ginning percentage and lint index, amount of fuzz on the seed, colour of the seed fuzz; (vii.) correlation studies: correlation between length of stigma and staple, correlation between ginning percentage and staple of lint.

There are two appendices, giving (1) correlation tables between the length of stigma and that of fibre; and (2) correlation tables between ginning percentage and length of staple.

633. THE CHROMOSOME NUMBERS OF INDIAN COTTONS. By I. Banerji. (*Ann. of Bot.*, xliii., 1929, p. 603.) Detailed examination shows that all the American (including Egyptian) cottons have 26 chromosomes, and all the Indian 13. Of the former, four American cottons acclimatized in India were examined, and of the latter the following: *Herbaceum* cottons: Hagari 25, Kumpta, Mysore local naked-seeded, Dharwar 1, Broach 6, Goghari, Wagad, 1027 A.L.F., I.A. Cylindrical boll, I.A. Long Boll; *Neglectum* cottons: A number of varieties, as well as W.N. 27, Wagale (yellow flowered), Wagale C. 19; *Indicum* cottons: Nandayal 14, Bani, Mungari 274, and var. Mollisoni; also *G. obtusifolium* Gammie, *G. cernuum* Tod, *G. arboreum*, Watt.

[*Cf.* Abstracts **498, 500, 513, 516, 520, 522.**]

634. THE BRANCHING OF EGYPTIAN COTTON PLANTS. By J. Templeton, D.Sc. (*Tech. and Sci. Serv. Bull. No.* 87, Bot. Section, Min. of Agr., Egypt, 1929.) The main stem of an average cotton plant of any Egyptian variety may be divided, from below upwards, into four more or less well-defined zones: (1) Where no branches of any kind are found; (2) where only monopodia are found; (3) where only sympodia occur; (4) where two sympodia or one sympodium and a single flower occur at each node.

The branching habit of the plant is of the greatest importance from the economic point of view. For example, the lower down on the stem the first sympodium occurs, other things being equal, the higher will be the yield. In addition to this, the lower down the first sympodium occurs the lower will be found nodes at which two sympodia or a sympodium and a single flower develop, which again means additional yield.

Among Egyptian varieties the great bulk of the yield is obtained from sympodial branches on the main stem. This is because the monopodia usually develop so high up on the stem that bolls produced on their sympodia develop so late in the season that they are nearly all destroyed by pink bollworms. For this reason plant breeders have, up to the present, always discarded all monopodial types as being unproductive, and have aimed at a plant which would be devoid of monopodia and would give sympodia at every node. Without any doubt such a plant would give a very high yield, but it is extremely unlikely that such a plant will ever be found, for all plants must first of all have a vegetative period before flower production begins.

Monopodia, or vegetative branches, in themselves are not a disadvantage. What really matters is their position on the main stem. If they are high up, as has been shown, they are conducive to a low yield. If low down, however, and the lower the better, the period between the development of their sympodia and those of the main stem will be shorter and consequently a yield would be got from them. In the extreme case, a plant which produces monopodia only in the axils of its cotyledons, or no higher on the main stem than the first leaf axil would, in the author's opinion, be very nearly the ideal cotton plant from the point of view of yield, for those branches would develop their sympodia and flowers almost *pari passu* with the main stem. Such a plant would have another great advantage under Egyptian conditions. Its flowering curve would rise more rapidly and reach a higher maximum than is usual with present varieties. It would also fall off rapidly, and consequently, even though it might start flowering a little later than existing varieties, its crop would probably "arrive" earlier. Incidentally, also, its flowering period would be shorter, and it would therefore suffer less from pink bollworm.

The author is of opinion that if plant breeders aimed at a type such as that described above, they would be more likely to attain their end—*i.e.*, a type giving the maximum possible yield—than if they continue to discard all monopodial types.

635. ABSCISSION IN GENERAL, AND WITH SPECIAL REFERENCE TO THE CURTAILMENT OF FRUITAGE IN GOSSYPIUM. By F. E. Lloyd. (*Mem. Hort. Soc. New York*, **3**, 1927. Abstr. from *Exp. Sta. Rec.*, lx., **9**, 1929, p. 809.) Abscission, here defined as a mode of activity of living cells whereby they separate from the tissues in which they occur, is chiefly of two types. In the first, separation of cells in place occurs by chemical alteration of the middle lamella and adjacent secondary walls. In the second, separation of the cells is produced by renewed meristematic activity and following chemical changes in the walls of the same kind. At the completion of separation the loosened cells are normally alive and capable of high turgidity. Abscission may or may not be accompanied by lignifications. There is no immediate or necessary connection between these processes, although there is a sort of harmony of relation.

Abscission in Gossypium is of the second type above noted. The various conditions known or supposed to lead to abscission of the buds, flowers, and fruit in the field as set forth include the destruction of pollen by rain, failure of anthers to open during low temperatures, injury, water stress, and mechanical strains due to disharmony of growth between pedicel and stem. Water stress may be procured both directly and by the lack of photosynthates due to insufficient light. It is argued that the mechanical strains set up can have no direct effect on abscission, which is said to proceed in the same fashion, whether or not such strains are present.

636. PLANT AND SOIL RELATIONS AT AND BELOW THE WILTING PERCENTAGE. By O. C. Magistad and J. F. Breazeale. (*Tech. Bull. No.* 25, Univ. of Ariz. Coll. of Agr., 1929.) This paper is partly a theoretical discussion and partly supported by experiment. The whole subject of water movement in the soil, the relation of plant growth to soil moisture, the relation of soil moisture to wilting, affords almost unlimited opportunity for important research work. We do not know by actual proof that plants are able to remove ions from the soil after the movement of water has ceased, but there seems good reason to suppose that if a contact of moisture film is continuous from plant to soil, and there is no proof that there is no such contact, ions might pass along this film from soil to plant. The gradual lowering of soil moisture below the wilting coefficient when other portions of the root system are supplied with available water, would indicate that below the wilting-point the water itself could be removed slowly.

In this paper the authors have discussed the forces at work and indicated the physical reasons for the relatively definite and uniform wilting point for all plants. They have brought also a new point of view in maintaining that the plant may even at the wilting point continue to draw on the nutrient material in the soil. If this is true—and every effort should be made to demonstrate it by experimental methods—the surface or plough layer of soil is much more important in dry-land agriculture than previously supposed. In many cases the dry-land crop draws water from this cultivated zone for only a few days after germination, and relies entirely on the deeper soil for its continued growth. The surface soil at or generally much below the wilting coefficient, if it gives up any of its nutrients, must do so with no movement of moisture or very little movement, and along films of water which are held very firmly to plant tissue and soil particles. It has been generally assumed that soil at this degree of dryness contributed no nutrient salts to the plant, since diffusion is at best a slow process, and when the film of water is reduced to a thickness of one hundred molecules movement has been assumed

to be negligible. The rapidity with which water is taken up by drought-enduring or drought-resistant plants would be more easily explained if these plants continually maintained an equilibrium with the soil about their roots. This bulletin is suggestive of important lines, which, if properly investigated, will further elucidate the complicated and imperfectly understood phenomenon of the balance between the water available and the water demand of desert and crop plants.—H.L.Stantz.

637. Ginning Percentage and Lint Index of Cotton in Relation to the Number of Cotton Fibres per Seed—the Effect of Environment on Ginning Percentage and the Determination of Unit Fibre-Weight. By A. J. Turner. (*Tech. Bull.*, Series B., No. 4, 1929.) The amount of lint borne on a single cotton seed is a matter of considerable economic importance. It is commonly represented by the ginning percentage—*i.e.*, the weight of lint expressed as a percentage of the weight of the seed-cotton from which the lint is obtained; a more modern method is by reference to the lint index—*i.e.*, the weight of cotton borne by 100 seeds; the relative merits of these two expressions are briefly discussed. The remainder of the paper is chiefly concerned with an examination of the relation of these two expressions to the number of fibres per seed, and the methods for determining this. It is pointed out that variation in lint-weight and seed-weight may be brought about by many different causes—viz., differences in the age and situation of seeds and bolls, and in the variety and conditions of growth of plants. The work of Leake, Balls, and Bird is then critically reviewed; the scopes of their investigations were different, and from the symbolical expressions for their several conclusions it is shown that the claim that their results are mutually confirmatory cannot be sustained. It is concluded that the lint index cannot be measured only by the number of fibres per seed, and that from the number of variables appearing in the equation for ginning percentage, no direct proportionality ought to be expected between the ginning percentage and the number of fibres per seed, or any other single property, whether volume of seed or unit fibre-weight. These conclusions are confirmed by an examination of the available data, including many new results obtained at the Technological Laboratory for various Indian cottons.

The conclusions of Balls that outturn fluctuations are due to differences in the environmental conditions on the day of flowering, and that the number of epidermal cells which sprout into hairs is determined by such differences, are examined at some length, and shown to be of doubtful tenability; it appears more probable that lint hairs continue to be differentiated after the day of flowering; and from Balls' experimental results it appears that the weight of lint per unit area of seed-surface is practically constant for different sizes of seed, and that this almost completely accounts for the fact that smaller seeds have a higher ginning percentage. Whereas Balls' view necessitates that the smaller seeds should each have a greater *total* number of fibres, it is shown that if we take the product of fibre-strength and fibre-length as a measure of unit fibre-weight, higher ginning percentage is more generally associated with a *smaller* number of fibres per seed. However, neither the total number of fibres per seed nor the number of fibres per unit area of seed-surface is directly proportional to the seed-weight or to the ginning percentage, so that these results do not enable us to decide whether or not the differentiation of all the lint cells takes place on the day of flowering, or what may be the influence of the environment on this differentiation.

It is pointed out that it is advantageous to study the ginning percentage of individual seeds, and a number of such results are given for the Bengal cotton, Aligarh A. 19, and for Punjab-American 4F. These cottons also display the property of association of high ginning percentage with low seed-weight; the weight of lint per unit seed-surface is practically the same on the average for the small, medium, and large 4F seeds, but fluctuates considerably for individual bolls of A. 19. From actual determinations of fibre-weight in each case, it is again concluded that neither the total number of fibres per seed nor the number per unit area of seed-surface is directly proportional either to the seed-weight or to the ginning percentage.

In order to determine the number of fibres per seed it is necessary to ascertain the weight of the single fibre, and the various methods of doing this are discussed. It has been claimed that for a given variety of cotton the fibre-weight per unit length is independent of the fibre-length. From an examination of the various possibilities in the development of lint on the seed, it is concluded that, if we take into consideration both the hereditary and environmental factors operating during the growth of the lint, the fibre-weight per unit length may differ for different lengths of fibre, and that in general a tendency may exist for the shorter fibres to have a rather greater fibre-weight per unit length. Results are given for certain Indian cottons which show not only that some varieties do display a greater fibre-weight per unit length for their short fibres, but also that in some cases the fibre-weight of individual fibres decreases very considerably from the middle of the fibre to the apex. These results hold good even for the fibres on an individual seed. The paper concludes with a description of a method for determining the average number of fibres of each group-length per seed, and summarizes the results so far published for the number of fibres per seed of different varieties of cotton.

638. THE STRUCTURE OF THE SEED COAT IN GOSSYPIUM, AND ITS RELATION TO THE GROWTH AND NUTRITION OF THE LINT HAIRS. By N. W. Barritt. (*Ann. of Bot.*, xliii., 1929, p. 483.) The structure of the seed coat is described and criticism is made of the account given by Balls of the development of the palisade layer. No development of the base of the hair cells occurs after differentiation, whilst the neighbouring epidermal cells develop enormously and subject the former to considerable lateral pressure which, together with the thickening of the wall, closes the lumen at the base of the hairs at an early stage.

In contradiction of Balls* it is maintained that the differentiation of the epidermal cells is not influenced by nutrition, and that the rise in the G. O. T. in the autumn can only be explained by a lack of correlation between the growth of the seed and the lint. This is related to the limiting effect of the palisade tissue.

The occurrence of well-developed stomata on the seed coat has not previously been recorded, and it is suggested that the nutrient liquid surrounding the developing lint hairs is secreted by the mesophyll tissue through the stomata into the boll cavity.

The occurrence of branched hairs is explained as a response to physiological requirement and not to local pressure as suggested by Denham.

The early closing of the lumen at the base of the hair, the continued increase in secondary thickening with extended maturation period of the boll, and the secretion of nutrient solution through the stomata all point to the nutrition of the lint hairs through the wall of the hair and not through the base as previously supposed.

The effect of climatic conditions on the functioning of the stomata is discussed in relation to cotton growing and selection.

CHEMISTRY, PHYSICS, ETC., IN THEIR APPLICATION TO COTTON PROBLEMS.

639. FIBRE DIAMETER. MEASURING DEVICE. By J. Ewles (Leeds). E.P. 308,080 of March 15, 1928. Abstr. from *Summ. of Curr. Lit.*, ix., **11**, 1929, L. 14.) The mean diameter of fibre in a wisp of fibres is measured by utilizing the diffraction of light rays.

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* Balls, "Development and Properties of Raw Cotton," pp. 100-103.

640. THE INFLUENCE OF SUBSTITUTED CATIONS ON THE PROPERTIES OF SOIL COLLOIDS. By M. S. Anderson. (Abstr. from *J. of Agr. Res.*, vol. xxxviii., No. 10, 1929, p. 565.) This paper deals with changes in properties that different soil colloids may undergo when the exchangeable bases are substituted by different cations. The data considered include determinations of the heat of wetting, adsorption of water vapour, swelling, moisture equivalent, cataphoresis, and pH of seven widely different colloidal materials when saturated with Ca, Mg, K, Na, H, and the cation of methylene blue.

641. SOME PROPERTIES OF THE CELL-WALL OF COTTON HAIRS. By N. W. Barritt. (*Ann. Appl. Biol.*, xvi., **3**, 1929, p. 438.) From the summary we quote: "The cell wall of the living cotton-hair is under tension, and its diameter is unaffected by osmotic pressure or the death of the cell. Increase of diameter of the uncollapsed hair by swelling in caustic soda varies inversely as the diameter of the hair in the case of fine cottons, and does not occur with coarse cottons. The diameter of the uncollapsed cotton hair varies inversely as the intrinsic strength of the collapsed hair."

642. THE EFFECT OF USING EITHER ONE HEAD OR TWO HEADS OF DRAWING INSTEAD OF THREE HEADS OF DRAWING IN THE SPINNING PREPARATION FOR SPINNING TESTS. By A. J. Turner. (*Tech. Bull. Ser. A.*, *No.* 11, 1929.) From the various test results it is clear that whether the card sliver is subjected to one, two, or three heads of drawing, makes little difference to the number of yarn-breakages sustained in the ring frame, or to the various yarn properties—viz., evenness, neppiness, strength, and extension.

643. FURTHER TESTS ON THE EFFECT OF TEMPERATURE AND HUMIDITY OF COTTON SPINNING. By A. J. Turner. (*Tech. Bull. Ser. A.*, *No.* 10, 1929.) The results obtained in the present tests confirm and extend those obtained in the previous tests. [*Cf.* Abstract 3, vol. v., in this Review] By reducing the relative humidity to below 30 per cent. a stage is reached when drawing cannot be carried out satisfactorily; moreover, yarn breakages on the ring frame become more numerous at this low humidity, the effect being especially pronounced in the higher counts which also have lower strength when spun under very dry conditions. It is accordingly concluded that although for Indian cottons spun into counts not higher than 40s, it is sufficient to keep the relative humidity rather above 30 per cent., yet, if higher counts were to be spun, bad spinning troubles would be still more in evidence, and it would be desirable to work at a higher relative humidity, say at least 40 per cent., or even higher for very fine counts. The yarns spun under the various conditions of temperature and humidity, while very similar in evenness and neppiness, yet differ widely in their appearance, for the yarns spun under the hot-dry conditions are very oozy indeed, full of snarls, and exceedingly crimpy; the yarns spun under medium-dry conditions suffer from the same defects to a lesser extent, whereas the yarns spun under normal and monsoon conditions are free from them. However, all these differences between the yarns almost entirely disappear when the yarns are conditioned by immersion in water.

644. A TWO-PHASE THEORY OF THE ABSORPTION OF WATER VAPOUR BY COTTON CELLULOSE. By F. T. Peirce. (*J. of Text. Inst.*, xx., **6**, 1929, T. 133.)

645. THE MECHANISM OF THE ADSORPTION OF WATER BY COTTON. By A. R. Urquhart. (*J. of Text. Inst.*, xx., **6**, 1929, T. 125.)

646. COTTON HAIR AND PLANT FIBRES: SWELLING IN CUPRAMMONIUM. By H. Müller. (*Faserforschung*, 1929, 7. Abstr. in *Summ. of Curr. Lit.*, ix., **8**, 1929, C. 23.)

647. THE REFLECTION OF LIGHT FROM CERTAIN SURFACES, AND ITS APPLICATION TO THE LUSTRE OF TEXTILE MATERIALS. By G. A. R. Foster. (*J. of Text. Inst.*, xx., **5**, 1929, T. 75.)

648. THE MICROSCOPICAL INVESTIGATION OF TEXTILE FIBRES AND FABRICS. By L. G. Lawrie. (Abstr. from *J. of Text. Inst.*, xx., **5**, 1929, p. 99.) A valuable summary of information on the uses to which the microscope can be put in the textile industry, with numerous plates.

649. THE ROTTING OF TEXTILES BY MICRO-ORGANISMS. By G. O. Searle. (*J. of Text. Inst.*, xx., **7**, 1929, T. 162.)

650. COTTON MILLS: HUMIDIFICATION AND VENTILATION. (*Text. Rec.*, **46**, 1928. Abstr. from *J. of Text. Inst.*, xx., **5**, 1929, A. 280.) A report of a lecture by R. Sutcliffe, giving the temperatures and humidities recommended for the various workrooms of a cotton mill.

651. COTTON WASTE AND ITS UTILIZATION. (*Text. Exporter*, iii., **27**, 1929, p. 31 and subsequent number.) Some practical notes on the subject.

CO-OPERATION.

652. CO-OPERATIVE GINNERIES. By J. S. Guleri. (Abstr. from *Seasonal Notes*, Punjab Agr. Dpt., vi., **1**, 1929, p. 39.) The requirements necessary for successful running are: A sufficient supply of cotton assured for the working season; adequate capital; business ability and experience of the right type; facilities in the way of situation, labour supply, and transport.

MISCELLANEOUS.

653. IMPERIAL AGRICULTURAL BUREAUX. The scheme embodied in this memorandum was agreed at a Conference held in London in November, 1928, attended by representatives of Governments of the Empire.

The purpose of Imperial Agricultural Bureaux is to act as effective clearing-houses for the interchange of information of value to research workers in agricultural science throughout the various parts of the Empire. The functions of such Bureaux include the following:

A. *Collection of Information.*—(i.) An index of research; (ii.) abstraction and collation of information; (iii.) keeping in touch with research in the Empire; (iv.) summarization of statistics.

B. *Distribution of Information* to officials, advisory officers, and research workers (to the latter, where feasible, bibliographies and photostat prints of articles on specific problems should be supplied on request).

C. *Publication* of special monographs—and in cases where found desirable, of a journal—to be made with the approval of the Executive Committee.

D. *General.*—Assistance to be rendered in the exchange of workers, facilitating meetings at convenient centres for those engaged in similar problems, exchange of material for research purposes, supply of information on the best centres for post-graduate study, etc.

Six Bureaux have already been established, viz.:

Animal Nutrition	Rowett Research Institute, Bucksburn, Aberdeen, Scotland.
Animal Genetics	Animal Breeding Research Department, Edinburgh University, Scotland.
Fruit Production	East Malling Research Station, East Malling, Kent, England.
Soil Science	Rothamsted Experimental Station, Harpenden, Herts, England.
Plant Genetics (Herbage plants)	Welsh Plant-Breeding Station, Aberystwyth, Wales.
Agricultural Parasitology ..	Institute of Agricultural Parasitology, St. Albans, England.

It is expected that the following two Bureaux will be opened during the summer of 1929:

Animal Health	Veterinary Research Laboratory, Weybridge, Surrey, England.
Plant Genetics—for plants other than Herbage	Plant-Breeding Institute, Cambridge University, England.

In dealing with the relations between the Imperial Agricultural Bureaux and research workers within the Empire, it is stated that the Bureaux are designed to assist research workers, but not to answer enquiries from the general public or give advice on the local problems confronting those engaged in agriculture, stock raising, or fruit growing. As each Bureau accumulates information on its special subject, it is expected that it will discharge all the functions assigned to it; it is stated, however, that "No Bureau can discharge such functions from its inner consciousness. It depends for its utility on the active support of research workers throughout the Empire. The measure of its opportunity is set by the support it receives from research workers, and the use they make of it."

To aid in the success of the scheme, official correspondents are to be appointed in all the countries concerned, with the exception of the United Kingdom, and close touch is to be maintained with these.

The offices of the Executive Council, which will have the general management and direction of all the Bureaux, will be at 2, Queen Anne's Gate Buildings, London, S.W. 1.

654. ABSTRACTS OF PAPERS ON AGRICULTURAL RESEARCH IN THE UNITED KINGDOM (1927-28). (Obtainable Min. of Agr. and Fisheries, London, price 1s. net.) A continuation for 1927-28 of a volume prepared for the Imperial Agricultural Research Conference, 1927. The papers abstracted have been limited to those dealing with results or methods of work. The abstracts have been made by the investigators themselves.

655. THIRD ANNUAL REPORT OF THE EMPIRE MARKETING BOARD, 1928-29. (H.M. Stat. Off., price 1s. net.) An account of how trade within the Empire has developed, given under the following heads: Progress in Empire Marketing; Scientific Research; Economic Investigation; Other Schemes; Publicity. Various appendices are included dealing with the following: List of Members of the Board and its Committees; Grants outstanding for Research and other Schemes; Exhibitions in which the Empire Marketing Board participated; Publications of the Board; Reports of the Imperial Economic Committee.

656. LE COTONNIER. Vol. I. By Ray C. P. Boone. (Soc. d'Editions Geographiques, Maritimes et Coloniales, 184, Boulevard Saint-Germain, Paris, 1929.) There is an interesting preface by Professor de Wildeman, calling attention to some of the most important points in the book. He gives a quotation from Professor Lecomte, stating that production is extending towards the East.

This first volume is largely devoted to the thorny question of specific grouping, more especially of the cultivated forms, in Gossypium. The author accepts the common division into *G. barbadense, hirsutum, herbaceum, indicum, neglectum, arboreum, religiosum*, etc. He calls attention to the many conditions that have to be fulfilled to make cotton a success in any given place, and to the advantages of one-locality—one-variety, co-operation amongst planters, and of breeding local varieties for local conditions. Heredity, hybridization, and selection are dealt with, and also the biology of the cotton plant. The volume ends with an extensive bibliography. The whole work, when complete, should prove of great value to many who are conducting enquiry into cotton questions.

657. FROM COTTON FIELDS TO FINISHED PRODUCT. (Abstr. from *Text. Merc.*, June, July, and August, 1929.) An interesting series of articles dealing chiefly with the manufacturer's end of the work, but there are two articles upon the geographical distribution of the cotton fields and upon the species and varieties of cotton grown. The whole work should prove very useful to students.

658. THE COTTON YEAR BOOK. (Pubd. by Industrial Newspapers, Ltd., London, 1929, price 7s. 6d. Abstr. from *J. of Text. Inst.*, xx., 6, 1929, P. 126.) In this, the twenty-fourth edition of the Year Book, special attention has been devoted to a survey of the efforts that have been made during the past year to lay bare the weaknesses that have impeded Lancashire's trade in the larger markets, and to suggest methods for its improvement. An interesting account is given of research carried on during 1928, and a section is also devoted to artificial silk.

659. THE COTTON SPINNERS' AND MANUFACTURERS' DIRECTORY FOR LANCASHIRE. (John Worrall Ltd., Oldham, pp. 488, 16s. net. Abstr. from *J. of Text. Inst.*, xx., 6, 1929, P. 127.) The forty-ninth edition of this well-known directory contains all its usual features, and is remarkable value at the price. This directory should be in the hands of all those engaged in Lancashire's staple industry.

660. DIE UNABHANGIGKEITSBESTREBUNGEN ENGLANDS, FRANKREICHS UND DEUTSCHLANDS IN IHRER BAUMWOLLVERSORGUNG. By Dr. R. E. Bühler. (Girsberger and Co., Zurich, 1929.) To obviate much of the variability of price of cotton, due to too great dependence upon the United States, is pointed out as the real objective of much of the extension of cultivation now going on, and the work of England, France, and Germany is considered. The first chapter deals with production in general, and the second with consumption. Many tables of figures are given, some based upon those of Todd in this journal, which go to emphasize the great monopoly possessed by the United States in production. Chapter III. deals with the price of cotton, and shows how all prices tend to follow that of American.

The second part of the book deals with the measures that are being taken in Europe to cope with the situation, and, after considering the International Union of Spinners and Manufacturers, discusses the work of the British Cotton Growing Association and the Empire Cotton Growing Corporation, and similar bodies in France and Germany. A full account is given of the history and activities of the Corporation. The colonies are dealt with in turn, and a full account is given of what has been done in each. The whole forms a useful compendium of the situation up to a couple of years ago.

Finally, in the eighth chapter, it is pointed out that though a good beginning has been made, dependence upon the United States in matters of supply and price is as yet practically the same, and there is still a long way to go. Our editorial of January, 1927, is quoted, and it is pointed out that the predictions there made are progressing towards fulfilment.

661. FIBRES, YARNS, AND FABRICS: TESTING. (*Verslagen en Mededeelingen van de Afdeeling Handel en Nijverheid van het Departement van Arbeid, Handel en Nijverheid*, Delft, Holland, 1928, No. 3. Abstr. in *Summ. of Curr. Lit.*, ix., 8, 1929, L. 7.) A pamphlet published by the Government Fibre Research Institute of Holland, giving details of the test methods in use there.

662. COST OF MANUFACTURING AND THE MULTIPLE SYSTEM OF LOOM OPERATION. By A. Palmer. (Abstr. from *Int. Cot. Bull.*, vii., 27, 1929, p. 498.) Discusses the subject under the following heads: Field for Cost Reduction; Components of Weaving Cost; How Many Looms per Weaver; Better Conditions and New Looms.

663. Modern Mill Management. (*Text. Exporter*, iii., **27**, 1929, p. 30.) Deals with the subject under the following heads: Detailed Costs; Preventable Waste; Standards of Waste; Standards of Supplies.

664. Cancer in Cotton Mills. (Abstr. from *Text. Exporter*, iii., **27**, 1929, p. 40.) A method of producing a purified lubricating oil, which does not produce cancerous growths, for use in cotton mills, was an important discovery made in the research laboratory of the Manchester Committee on cancer during the past year.

665. Artificial Cotton. Characteristics. By C. H. Pease. (*Text. World*, **75**, 1929. Abstr. from *J. of Text. Inst.*, xx., **6**, 1929, A. 291.) The author discusses the reports on artificial cotton which have appeared in the Press. An examination of a sample of the fibre showed that it was derived from a plant of the milkweed family. A picture is given of one common member—namely, *Asclepias galiodes*—which grows in Colorado. The yellowish fibres are smooth and shiny, and will slip over one another, thus making a weak thread. Considering the large number of plants which produce fibres, and recent attempts to exploit banana and other plant fibres which have been unsuccessful, there does not seem to be any cause for alarm among cotton planters.

666. A Substitute for Cotton. In the *Textile Mercury* of June 1, "A Contributor" writes upon this subject without giving the name of the fibre he describes. He considers it to be a bast fibre, giving the reactions of practically pure cellulose. The fibres varied from ½ to 1½ inches in length, with an average of perhaps ¾ inch. They are of spindle shape, and show great variation in thickness; they are much weaker than cotton in tensile strength (102 against an average of 126 for cottons of the varieties from Sea Island downwards). The fibre lacks the corded edges and the natural convolutions of cotton, so that it will not be easy to spin, and it also lacks the hollow core which is so useful in absorbing moisture, liquids, and dyestuffs.

667. Kapok. (Abstr. from *Trop. Agr.*, vi., **6**, 1929, p. 169.) Mr. A. A. Ritchie, Entomologist to the Dept. of Agr., Tanganyika, states that owing to the general relationship of cotton and kapok, the Department has made enquiries as to whether kapok can be grown in the Territory without deleterious effect on the quality of the cotton. The problem centres itself round the inter-relation of the two crops with the red stainer, which subsists and multiplies on the bolls of both. In Tanganyika the problem is simplified by the fact that the kapok cropping season is December to February, when in the major cotton districts cotton plants have already been, or are about to be, uprooted. Any increase of red stainer consequent upon the falling of kapok is then unable to have any soiling effect on cotton lint, the crop having already been made. The growing of kapok is, therefore, considered as practicable without interfering with cotton interests.

668. Lancashire Cotton Industry: Localization. By J. Jewkes. (*Man. Guar. Coml.*, **18**, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **9**, 1929, M. 9.) The concentration of the English cotton industry in Lancashire, and the association of special areas in the county with special types and qualities of goods can be accounted for satisfactorily, but the technical and geographical separation of spinning and weaving is more difficult to explain. The technical separation is probably due to the fact that spinning and weaving demand different sizes of plant for maximum technical efficiency. Recent investigations show that the geographical separation cannot be explained by local conditions of humidity. A study of the history of the cotton industry reveals the fact that in 1850 "mixed" firms were fairly widespread and the nucleus of the industry centred in Manchester, though tending to move out of the city itself. Specialization and the weaving industry in the north developed during the period 1850 to 1880, and since that time specialization has become even more marked. It is suggested that this development was due, among other reasons, to the differences in demand for labour and in the development of labour-saving devices in the two sections. To those who advocate vertical firms for Lancashire, it may be pointed out that it is only recently that Lancashire discarded the mixed firm.

669. LANCASHIRE BETRAYED. By E. E. Canney. (John Heywood, Ltd., Manchester. 3s. 6d. net. Abstr. from *Text. Rec.*, xlvii., **556**, 1929, p. 81.) A book of 120 pages, being a collection of essays on cotton trade politics. The author discusses the great disparities still existing between retail and wholesale prices, the remarkable development of shopping quarters, the burden of loan and mortgage interest, the prime necessity for cheap finance, the manner in which loan holders have fared well out of the losses of the shareholders, the unfair burdens borne by the cotton industry, the prospects for trade recovery, and the damaging effect of deflation. A foreword is contributed by Mr. Fred Holroyd, the president of the International Federation, who very heartily commends the book to the serious attention of the trade.

670. MARKETS FOR COTTON TEXTILES. By Sir Ernest Thompson. (Abstr. from *World Textiles* No. of *Man. Guar. Coml.*, July 11, 1929.) An exhaustive survey of the world consumption of cotton textiles, illustrated by charts.

671. THE ROAD TO INCREASED TRADE. By H. W. Lee. (Abstr. from *World Textiles* No. of *Man. Guar. Coml.*, of July 11, 1929.) In this article the author makes an appeal for co-operation in Lancashire.

672. THE INTERNATIONAL INSTITUTE OF AGRICULTURE, ROME. In a note recently received it is stated that in the early part of the year Professor Alessandro Brizi was appointed Secretary General, and his expert knowledge has already proved of the highest value to the technical services of the Institute. Two important international meetings have been held during this year, one being the International Diplomatic Conference for Plant Protection, the result of which was the approval by twenty-eight countries of an International Convention, of which the Italian Government is now the Depository. The Permanent Committee has decided to call a meeting of the Commission for Tropical and Sub-Tropical Agriculture of the Institute's Scientific Council for an early date, and in addition a meeting of the Economic Agricultural Committee has been summoned for October next. It is stated that in all probability there will be a resumption during the summer months of the negotiations between the President of the Institute, Senator de Michelis, and Sir Eric Drummond, General Secretary of the League of Nations, to determine the relations which should properly exist between the two Institutions, with special regard to the study of economic problems which have a direct bearing upon agriculture.

673. JEALOTT'S HILL AGRICULTURAL RESEARCH STATION. The important new agricultural research station of Imperial Chemical Industries, Limited, at Jealott's Hill (Warfield, Berks), was formally opened by the Rt. Hon. J. H. Thomas, M.P. (Lord Privy Seal), on June 28. The station comprises two farms, Jealott's Hill and Nuptown; the former (360 acres) is the new research headquarters of the distributive and research organization for the farm fertilizers side of Imperial Chemical Industries.

Lord Melchett, in his speech proposing the toast of "Agricultural Research at Home and throughout the Empire," pointed out that the man following agriculture, oldest of the industries, was the least regarded and the worst remunerated, while agriculture has received, on the whole, relatively a much less amount of scientific attention than other industries which are more modern. The Rt. Hon.

J. H. Thomas in replying said that a welcome change was coming over the subject, and that capital and labour, research and industry, must work together and supplement one another.

ADDENDA.

674. NYASALAND. *Cotton Cultivation.* From the *Ann. Rpt. of the Dpt. of Agr.*, 1928, recently received, we learn that the cotton acreage in European hands has declined in recent years, but there has been a substantial increase in production by natives. The variety "Over-the-Top" gave encouraging results on trial plots organized by the Corporation on various estates, and there was a good demand for this strain for planting in rotation with tobacco.

The agreement with the British Cotton Growing Association is discussed, but Mr. Ducker has already described the essential features of its operations in his article (*Cf.* p. 327 above).

Annexure IV. of the Report deals with the work of the Corporation at Makwapala and Pord Herald Experimental Stations. At Makwapala the variety of cotton chiefly tried was "Over-the-Top," and work was continued for a fourth year in the study of possible rotations. In connection with the study of insect pests, it is considered that bollworm may be sufficiently controlled by suitable rotations to allow of a reasonable yield of cotton being made, but that control of cotton stainers still remains a fundamental problem. At Port Herald several varieties of cotton were under trial on a considerable scale. Two strains from Barberton—U 4/5 and A 12/2—gave promising results, the former proving, on the whole, superior.

Proposals were set on foot during the year by Mr. Ducker for the opening of a cotton station in the Dowa district, with a view to studying the special cotton problems of the Lake Shore; a suitable plot of land has been selected, and it is expected that the initial operations will commence very shortly. To the north and south of the proposed station are comparatively large tracts of potential cotton land, and looking to the possibility of railway development, investigational work in this area assumes special importance.

675. INDIA. *Use of Indian Cotton in Belgian Mills. Cf.* Abstract **539.**

676. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d. post free.) The first number of Series A. Genetics has recently been issued, and contains the following papers reprinted from the *Jour. of Genetics*:

STUDIES ON THE INHERITANCE OF (*a*) PETAL SPOT, (*b*) POLLEN COLOUR, AND (*c*) COROLLA COLOUR IN THE COTTON PLANT. By S. C. Harland. (*a*) *The Inheritance of Petal Spot in New World Cottons.*—The results obtained and described in this paper show how a genetic difference can be affected by modifying genes, so as to show sharp segregation, or to bring the dominant so close to the recessive in appearance that it becomes indistinguishable from it. It is clear, for example, that extinguished spot is allelomorphic to a lower grade of spot, although both are normally invisible.

The main points demonstrated in the paper may be summarized thus:

(1) Weak spot of Trinidad Red Kidney (S^w) is allelomorphic to spotless Upland (S^o), and linkage exists between S^w and R (red).

(2) Extinguished spot of Cassava (S^c) is allelomorphic to spotless Upland, S^o, and linkage exists between S^c and R.

(3) Full spot of Pima Egyptian (S^s) is allelomorphic to extinguished spot of Cassava, S^e, and linkage exists between S^s and R.

(4) Full spot of Sea Island, S^s, is allelomorphic to weak spot of TRK, S^w, and linkage exists between S^s and R.

(5) Switching over of the linkage to a repulsion type indicates that full spot,

weak spot (and/or extinguished spot), and spotless form a system of multiple allelomorphs.

(6) Red and spot of the multiple allelomorph series are linked with 4·3 per cent. of cross-overs.

(7) Full spot of Pima Egyptian, S^s, is allelomorphic to intermediate spot of Grenadines White Pollen (S^i).

(8) Full spot of Grenadines Naked, S^s, is allelomorphic to faint spot (S^f), of Jamaica Long Staple.

(9) Weak spot of TRK, S^w, is allelomorphic to faint spot of Jamaica Long Staple, S^f, since R and weak spot are linked.

(10) Strong spot, above grade 7, in Upland × Sea Island White may be due to two complementary linked genes, but the evidence is not complete.

(11) The main gene for strong spot in (Upland × Sea Island) × Sea Island is linked with Y (yellow corolla) with 25 per cent. crossing-over

(12) In this cross linkage also exists between Y and a spot modifier with 20 to 33 per cent. crossing-over.

(13) The spot gene linked with Y is not the same as the spot gene linked with R.

(14) Modifying factors may profoundly affect the development of spot in a plus or minus direction.

(*b*) *The Inheritance of Pollen Colour in New World Cottons.*—The experiments here described illustrate the fact that the sharpness of the distinction between the dominant gene P (yellow) and the recessive p (pale cream) depends upon the genetic background. Yellow and pale cream form a simple pair of factors. Modifying genes act on the basal gene for yellow, producing a complex series of shades from pale yellow 0·5 to deep golden 4·0. P produces little effect when unsupported by modifiers, and it is possible that in the absence of any modifier at all, the distinction between P and p would vanish.

(*c*) *The Inheritance of Corolla Colour in New World Cottons.*—The following summary is given: (1) Pale cream of Upland or Sea Island White, and yellow of grades 1 to 7, form an allelomorphic pair of characters which may be represented by the factor pair Y-y.

(2) Segregation in inter-specific crosses is more complicated than in inter-Peruvian crosses, in that many intermediate grades of yellow are found in F_2. In the inter-Peruvian cross involving Sea Island White there is sharp segregation in F_2, with absence of intermediate grades.

(3) Upland and Sea Island White are both genetically y, but Sea Island White, having arisen directly from the yellow form by a single locus mutation, possesses a series of plus modifiers for yellow, while Upland possesses fewer modifiers. Segregation of modifiers produces the intermediate grades of yellow.

(4) The total number of modifiers is not known, nor has the attempt made to distinguish their specific effects been successful. Probably not less than two nor more than seven modifiers are concerned.

(5) The occurrence of grades lighter or darker than the parents in the F_2 of a cross between two yellows is considered to be due to new combinations of intensifiers.

(6) Some Uplands have intensifiers capable of raising Sea Island from grade 4 to grade 6, but there is no case where Upland has intensified the colour of a Bourbon variety.

PUBLICATIONS RECEIVED

We have to acknowledge the receipt of the following publications for the Library:

From the South-Eastern Agricultural College, Wye.

The Journal, No. 26, 1929.

From Faculté des Sciences de Marseille, Musée Coloniale.

Baudon, M. A.: *Contribution à l'étude des Plantes Oleagineuses de l'Afrique Équatoriale.*

From the Library of the State Institute of Experimental Agronomy Bureau of Agricultural Bibliography, Leningrad.

Catalogue of Agricultural Books printed in 1923-1925. After the materials collected by A. D. Pedashenko. (In Russian.)

PERSONAL NOTES

APPOINTMENTS.

Southern Rhodesia.

Mr. A. N. Prentice has been appointed by the Corporation Assistant at the Plant-Breeding Station, Gatooma.

Sudan.

Mr. R. L. Knight has been appointed by the Corporation as Assistant to Mr. Bailey, at Shambat, Khartoum.

The following holders of Senior Studentships last year have obtained appointments in the Government Agricultural Services as under:

Mr. R. H. Fraser	Northern Rhodesia.
Mr. C. W. L. Fishlock	Uganda.
Mr. C. W. Lynn	Gold Coast.
Mr. R. Turner	Nigeria.

STUDENTSHIPS.

The Studentships awarded last year to R. H. Davidson, S. T. Hoyle, A. J. Kerr, and E. O. Pearson, have been confirmed for a second year, and will be tenable at the Imperial College of Tropical Agriculture, Trinidad. The following have also been elected to Studentships, which will be tenable for the first year at Cambridge University: W. L. Fielding, W. G. M. Irving, J. D. Jameson, and H. I. Moore.

In addition to the above, a special Studentship for a year's Study Leave at the School of Agriculture, Cambridge, has been granted to Mr. A. H. McKinstry, Assistant Plant Breeder at the Gatooma Plant Breeding Station, Southern Rhodesia.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the colonies.

At the date of writing, the following officers are on leave in England from cotton-growing countries:

Gold Coast	Mr. C. W. J. Line.
,, ,,	Mr. A. C. Miles.
,, ,,	Mr. F. A. Robb.
,, ,,	Mr. J. Steele.
Nigeria	Mr. H. Greenwood
,,	Mr. J. G. Roynard.
,,	Mr. H. Roebuck.
,,	Mr. O. S. Swainson.
,,	Mr. J. W. Wallace.
,,	Mr. J. F. Ward.
,,	Mr. C. H. Wright.
Nyasaland	Mr. A. S. W. Hornby.
,,	Mr. W. P. Tyler.
,,	Mr. E. J. Wortley.
Tanganyika	Mr. A. E. Harrer.
,,	Mr. D. Sturdy.
,,	Mr. E. Ward.
,,	M. H. Wolfe.
Uganda	Mr. C. G. Hansford.
,,	Mr. G. T. Philpott.
,,	Mr. A. L. Stephens.
,,	Major N. G. Wright.

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